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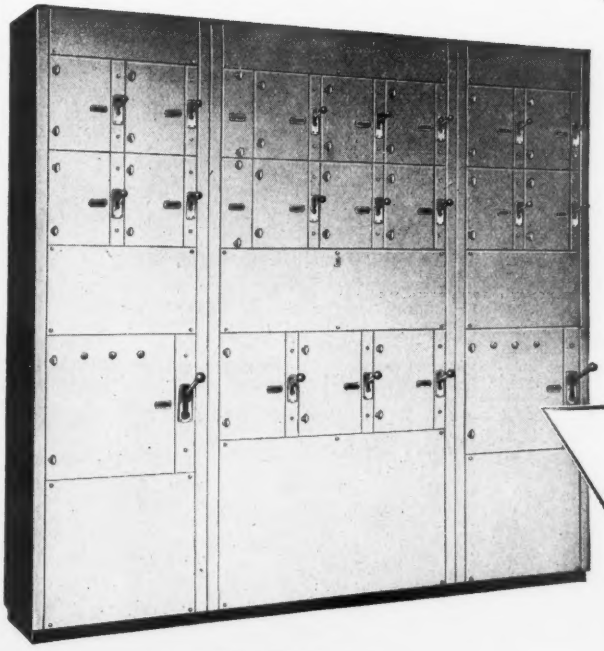

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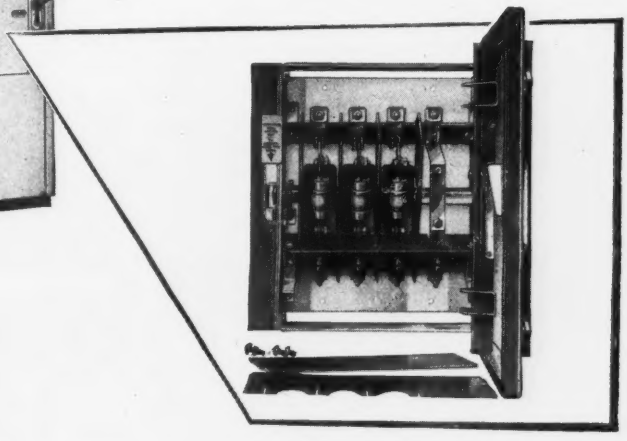

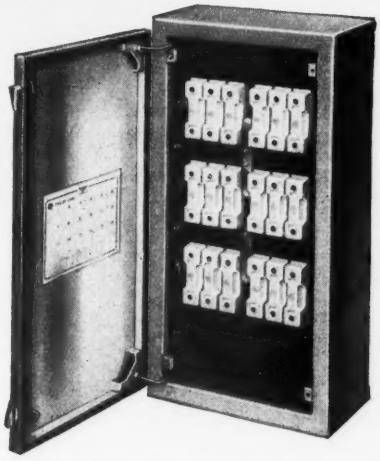

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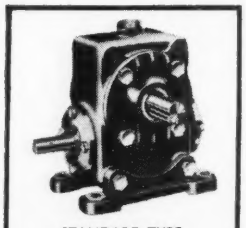
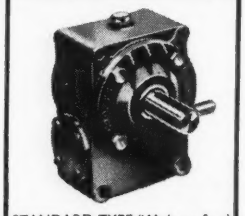
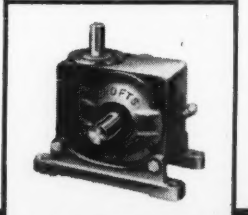
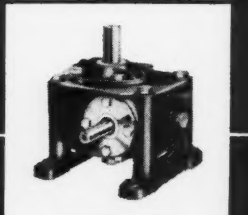
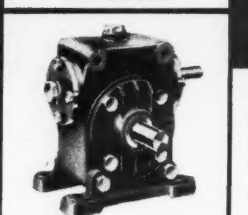

STANDARD TYPE

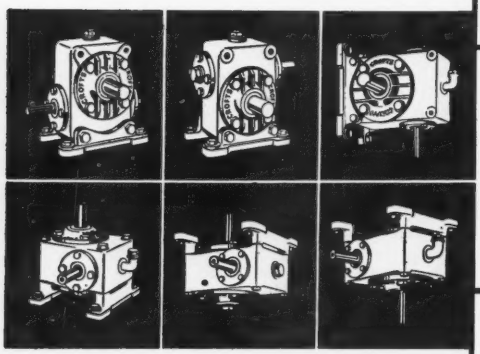

STANDARD TYPE (Without feet)

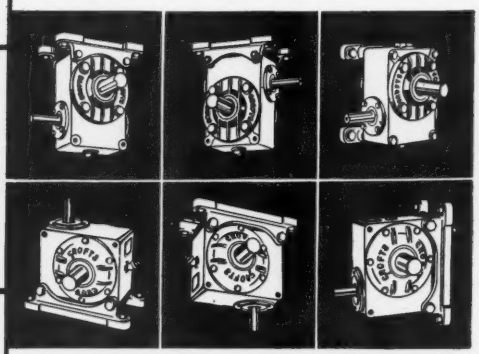

'D' MOUNTING TYPE


VERTICAL TYPE


INVERTED TYPE

Using any of the three foot designs or by bolting the basic gear without feet directly on to your machinery you can get any mounting position you like with this truly universal mounting worm reduction gear. Any size is available as a complete worm geared motor.





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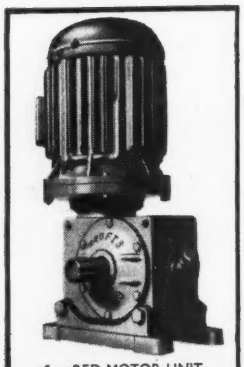
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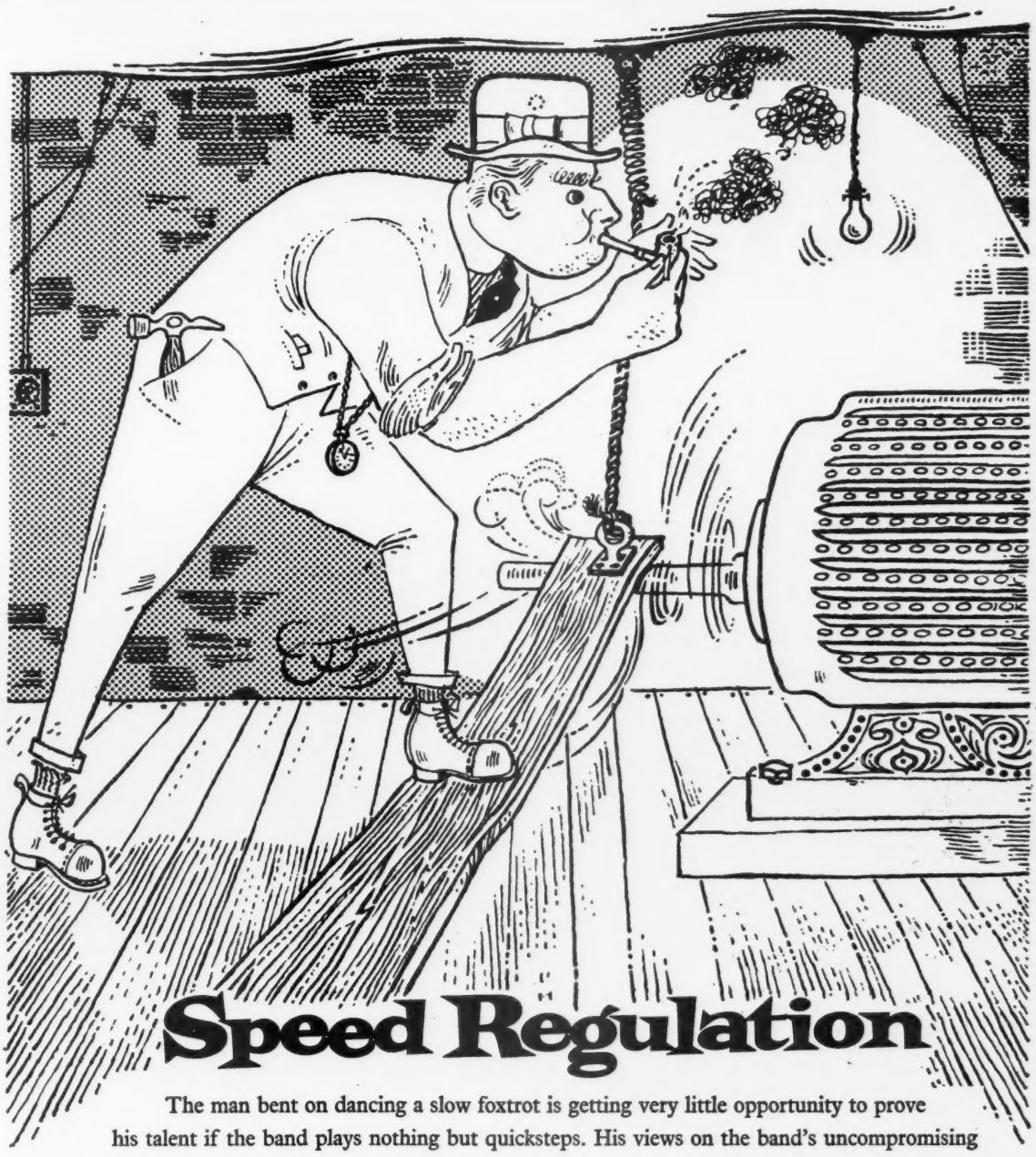

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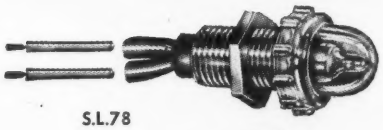
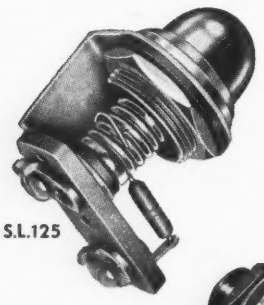
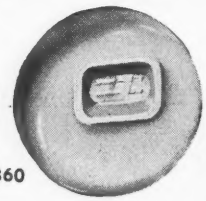


S.L.78

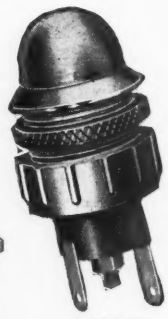
S.L.120



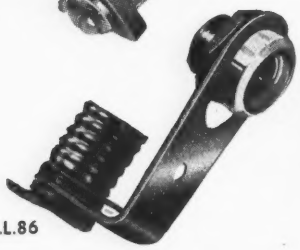
S.L.125



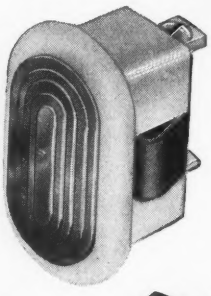
S.L.860



S.L.90/SB



S.L.86



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S.L.125: New design with M.E.S. neon tube, built-in resistor and screw terminals.

S.L.860: Entirely surface mounting

S.L.50: Snap-in fixing.

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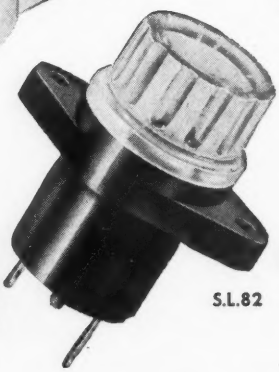
S.L.82: M.E.S. holder ZA4201.

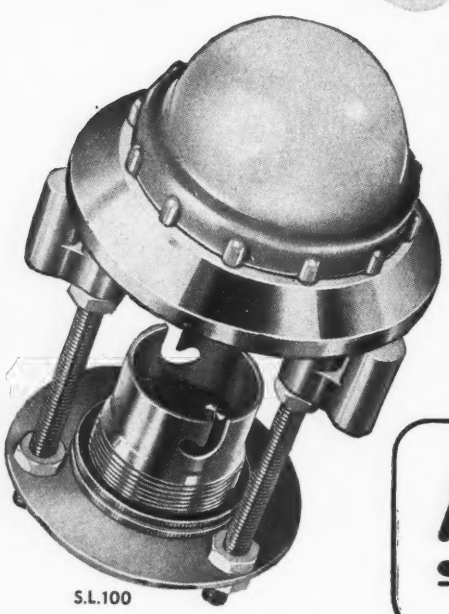
S.L.86: Low cost M.E.S. holder.



S.L.82

mains

S.L.100: Designed for 15 watt B.C. sign lamps.



S.L.100

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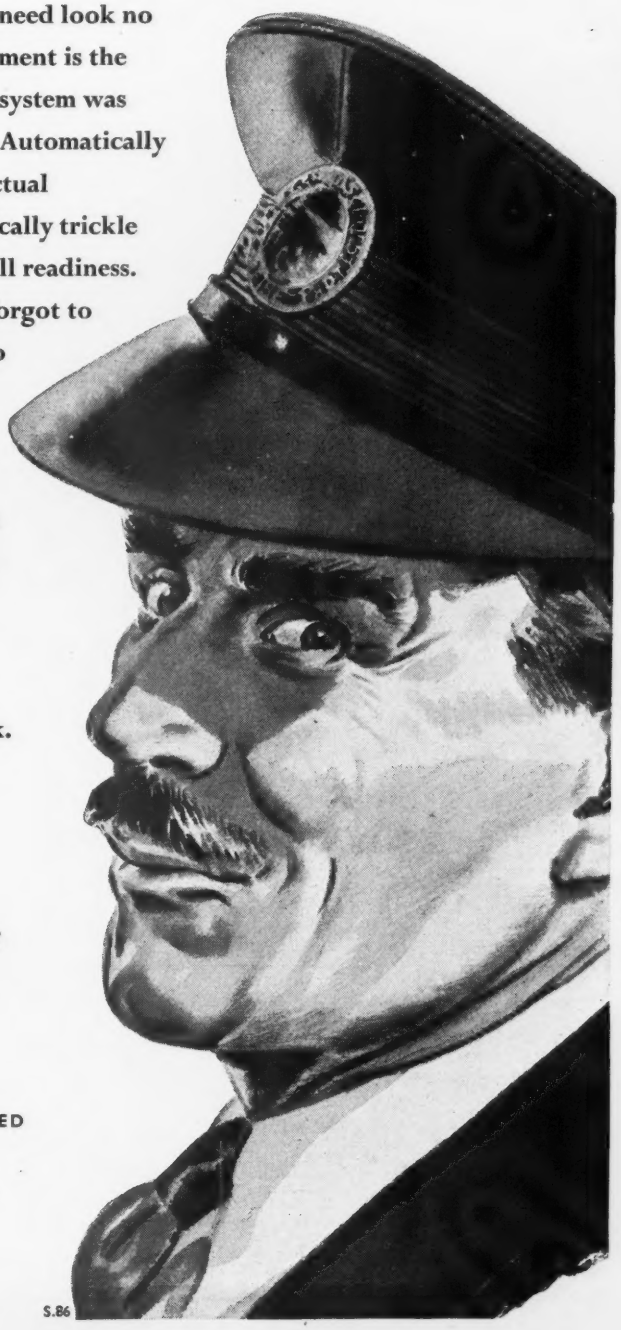

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S.86

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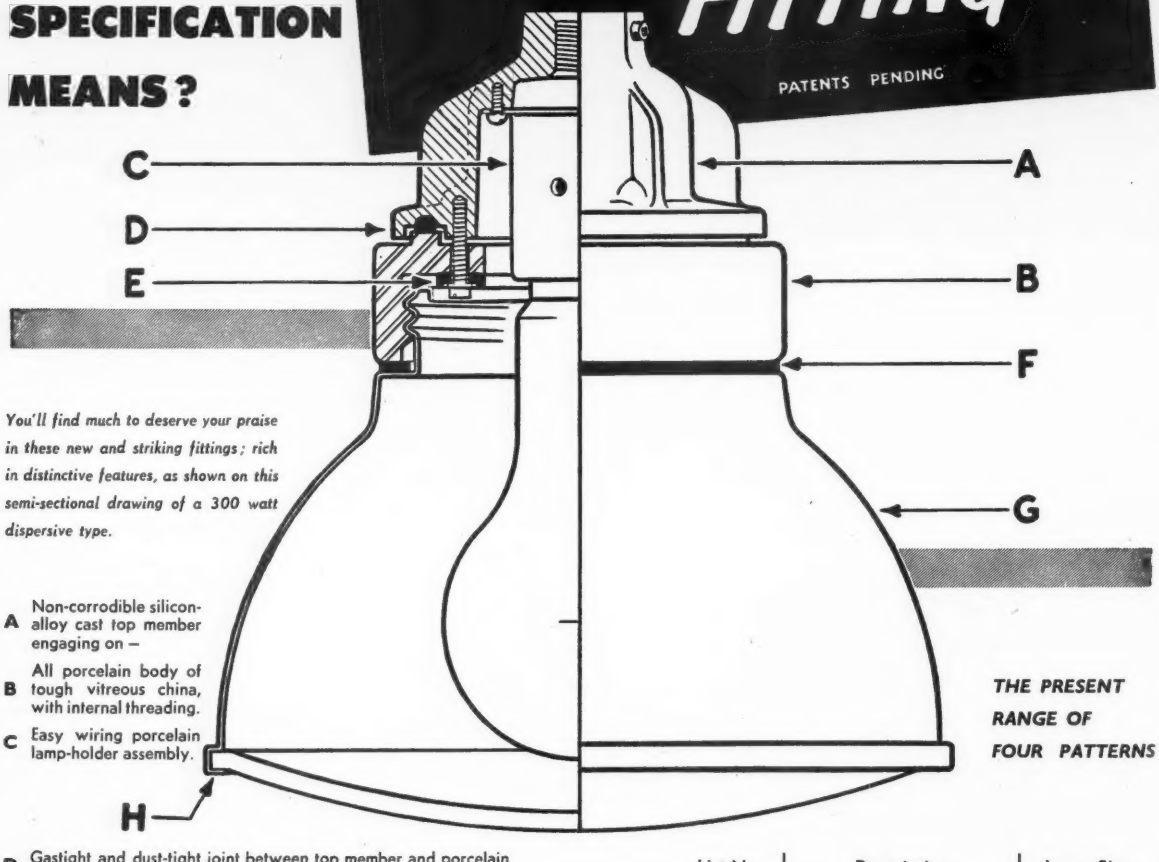

You'll find much to deserve your praise in these new and striking fittings; rich in distinctive features, as shown on this semi-sectional drawing of a 300 watt dispersive type.

A Non-corrodible silicon-alloy cast top member engaging on –

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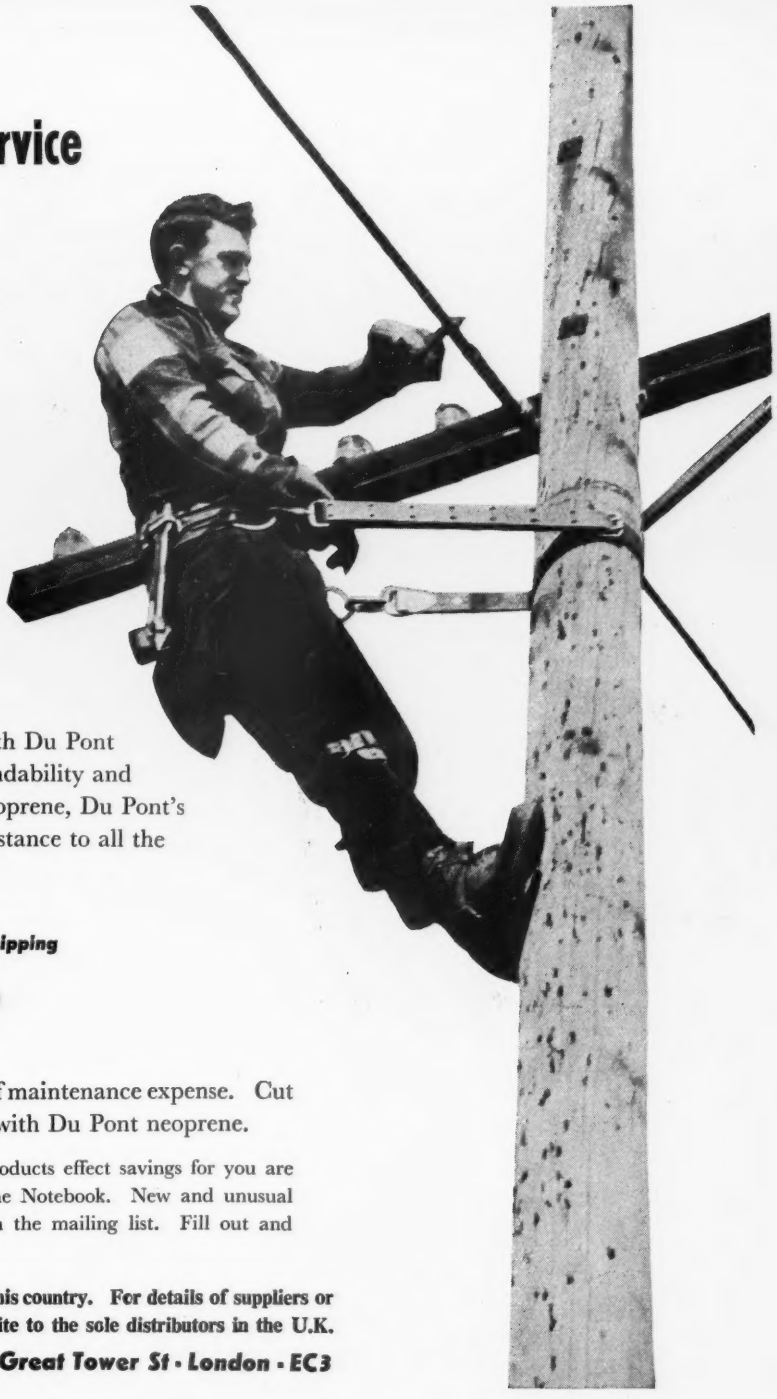

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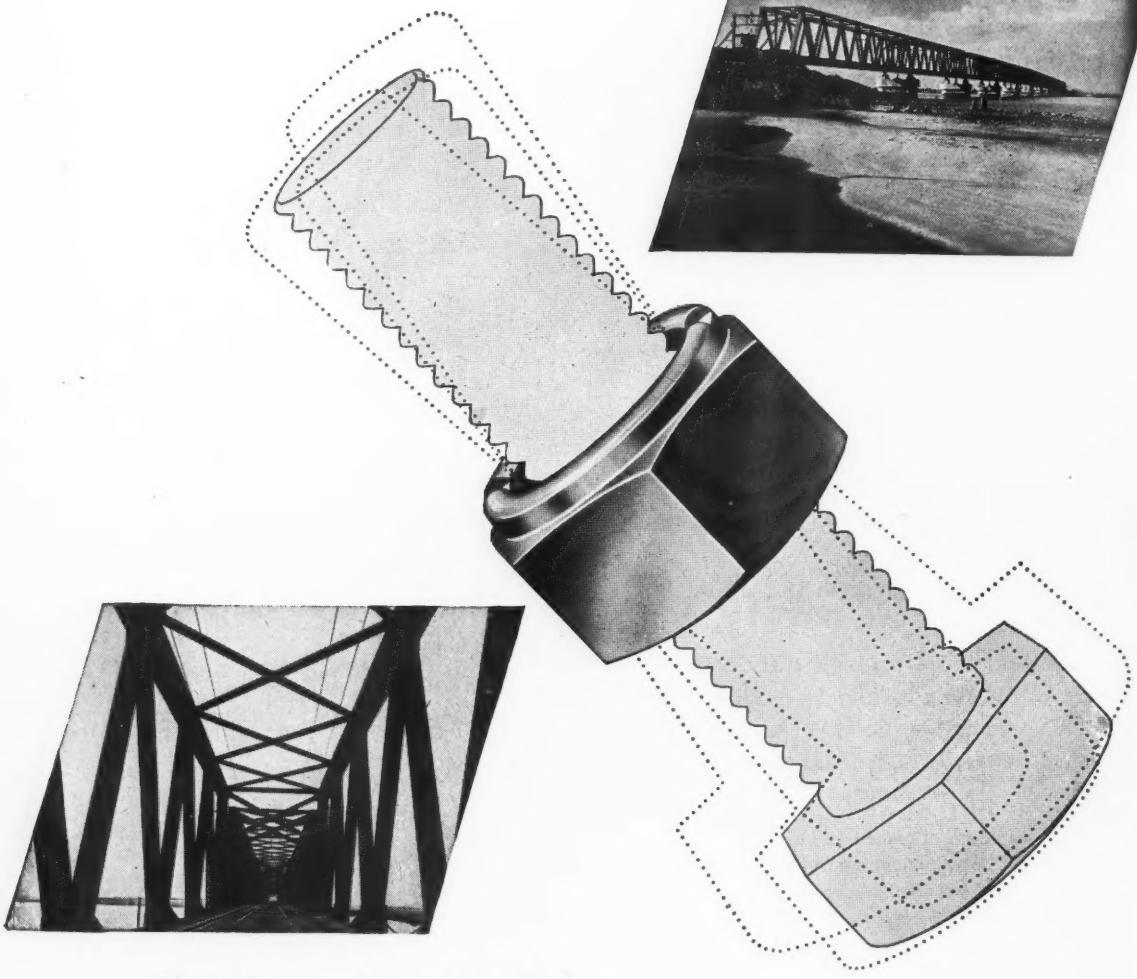

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CRC 32H

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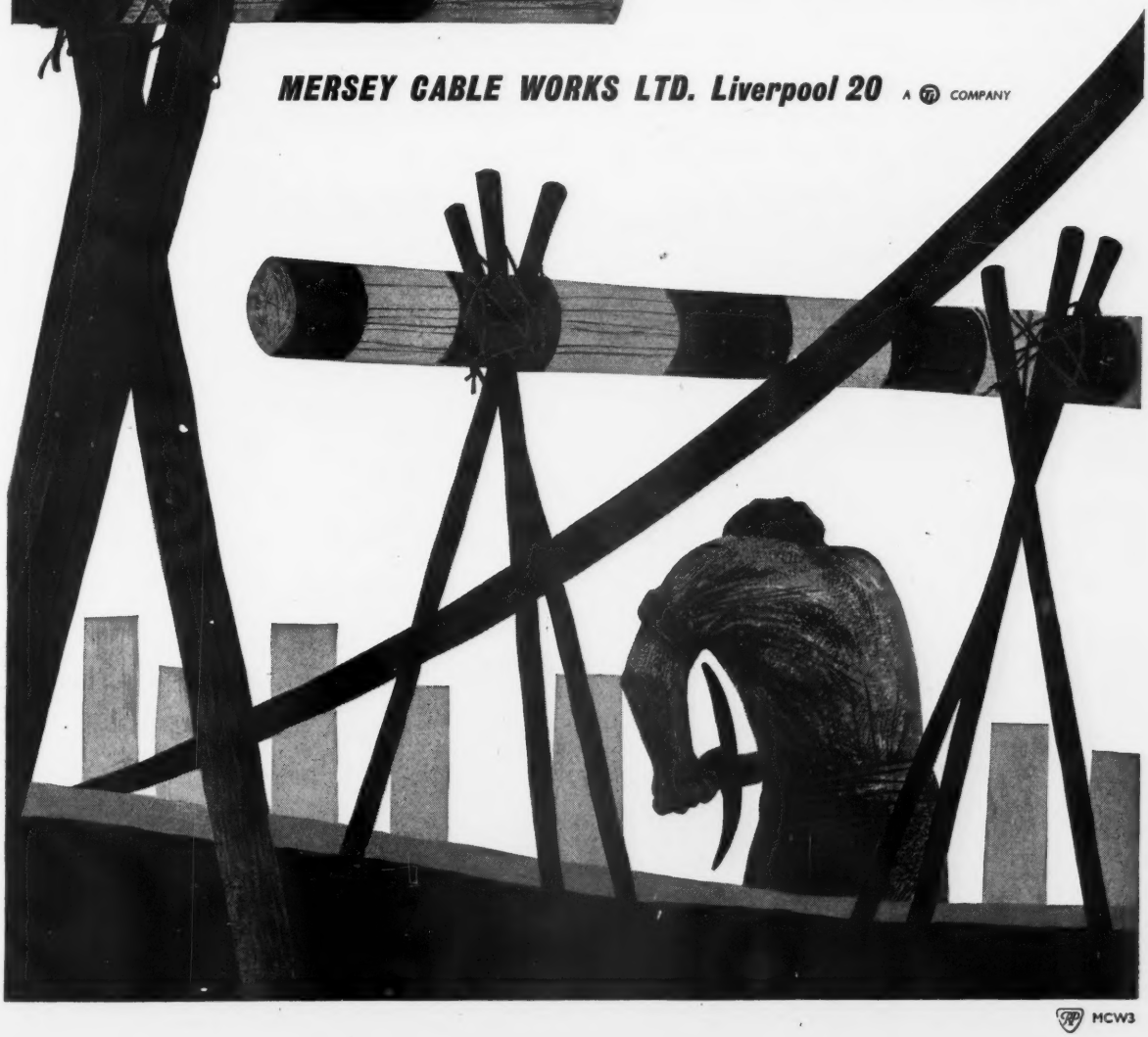

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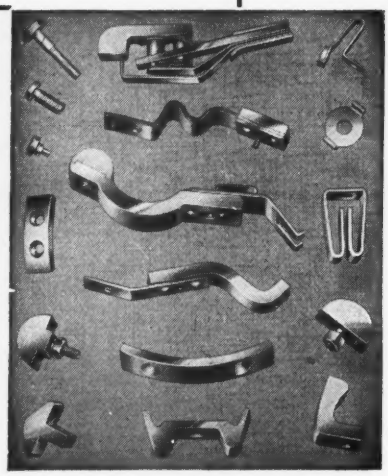

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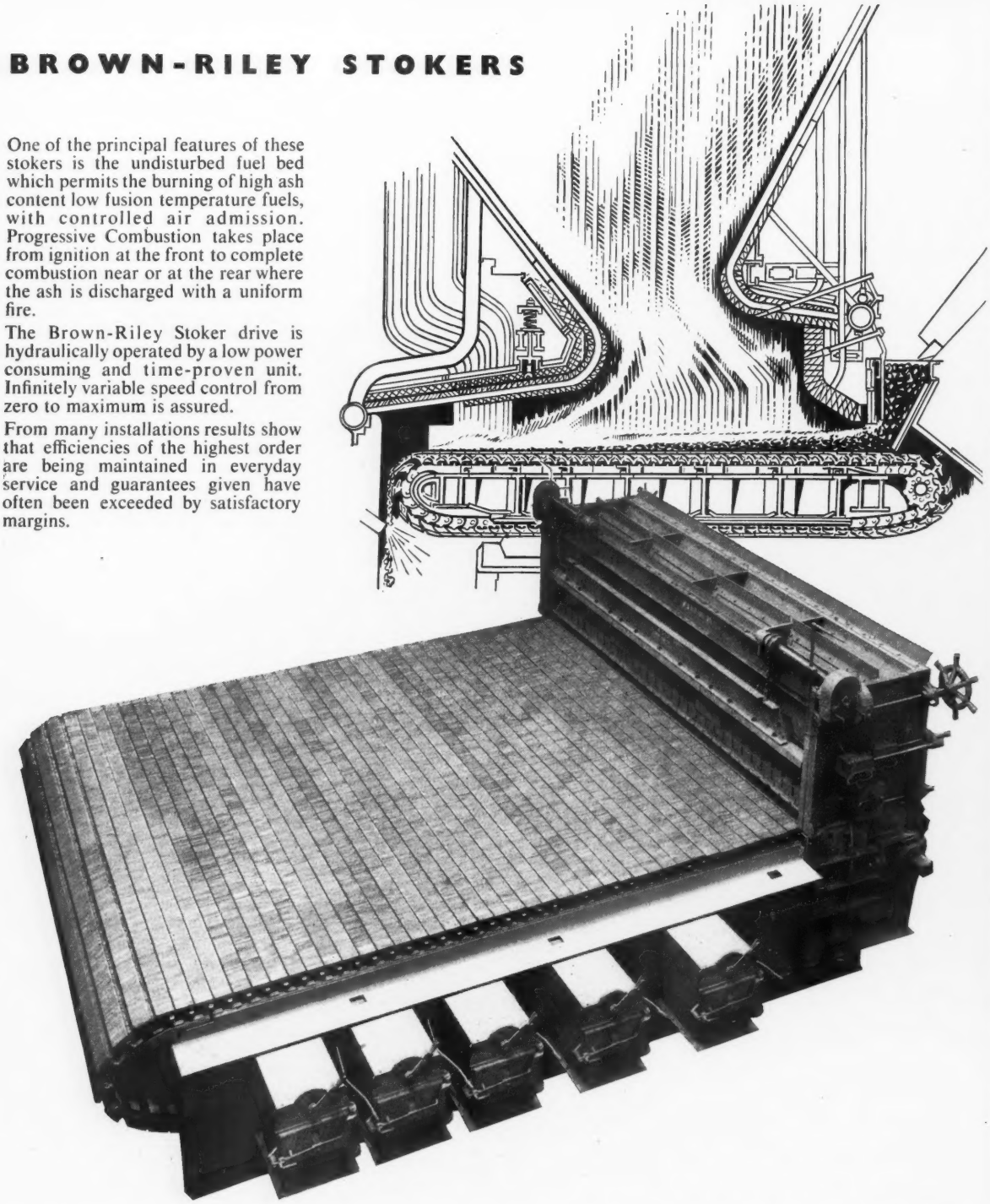

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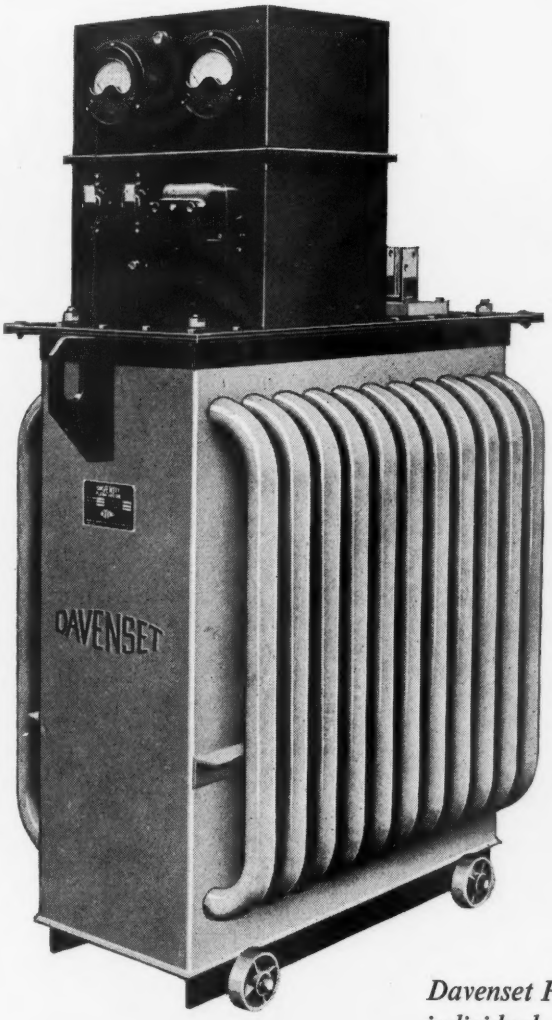

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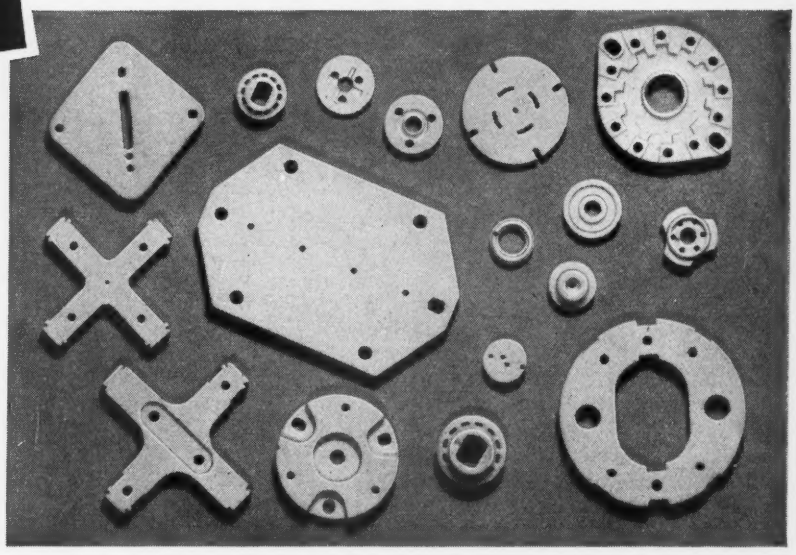

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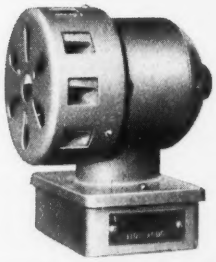

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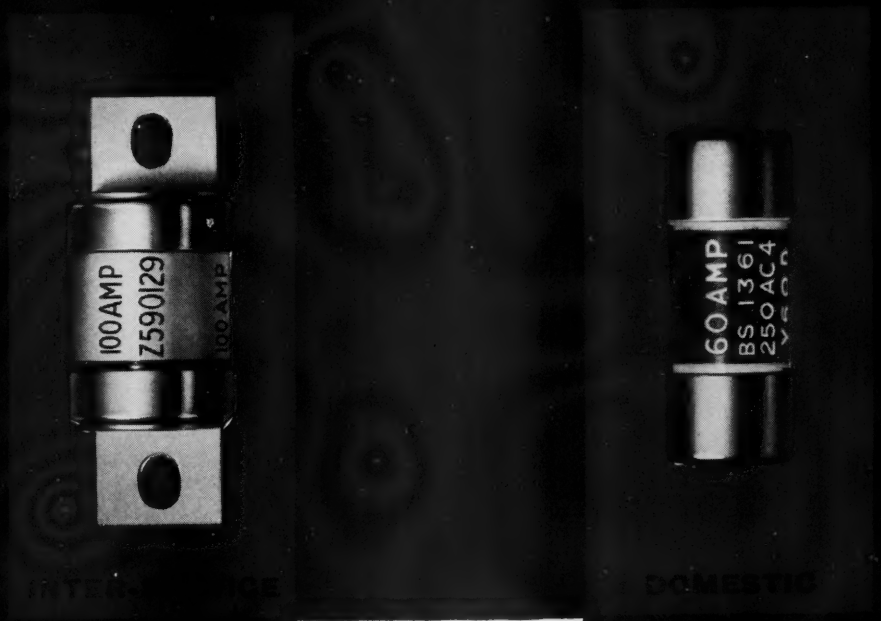

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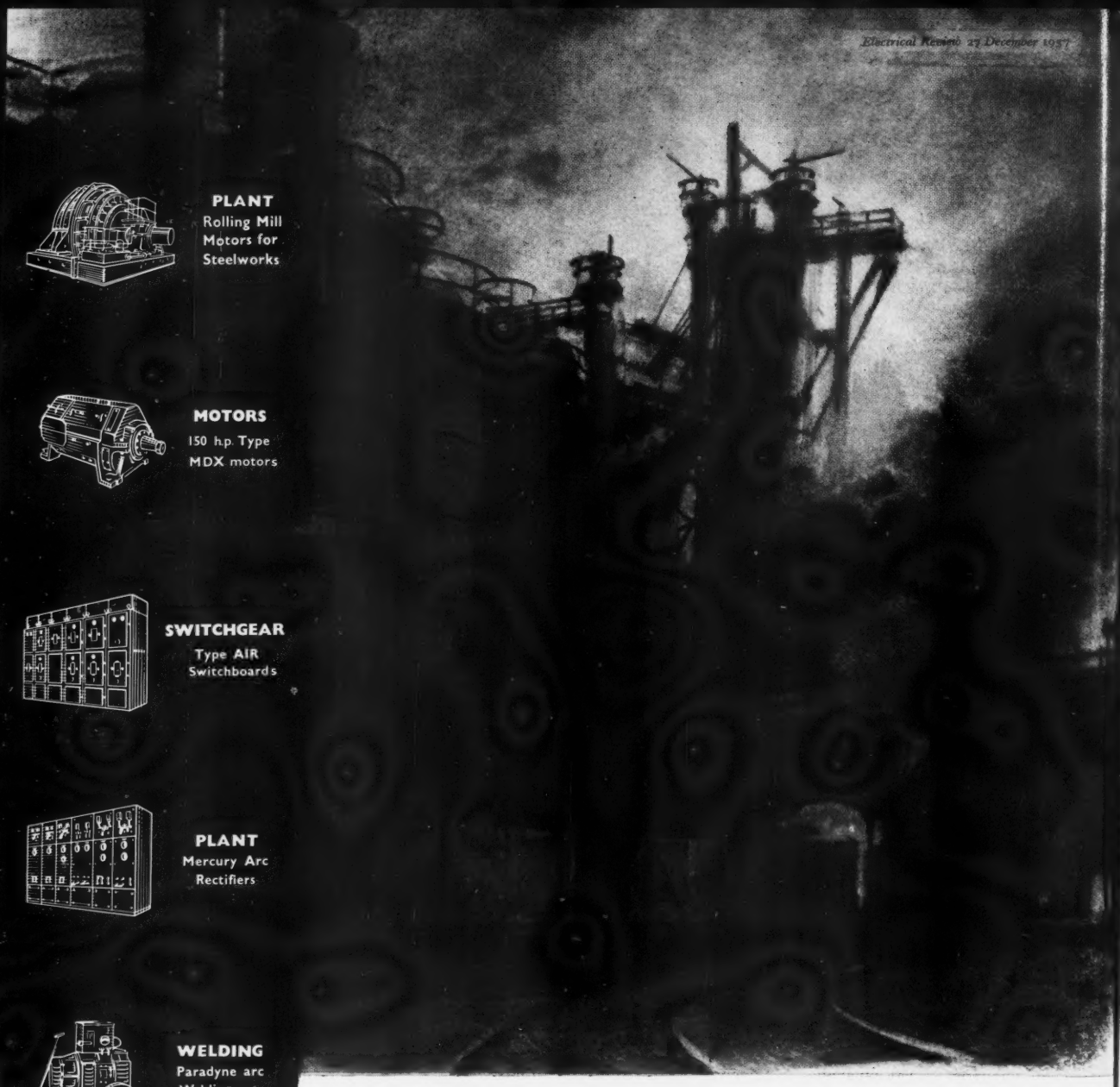

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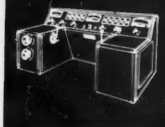

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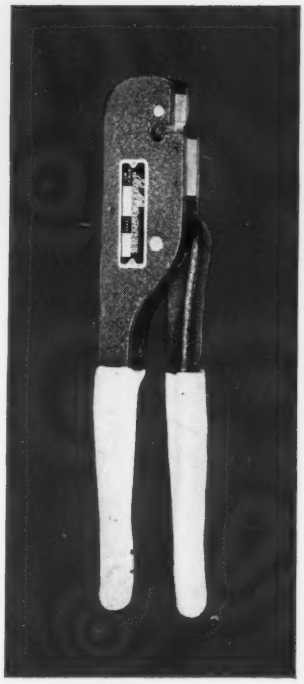

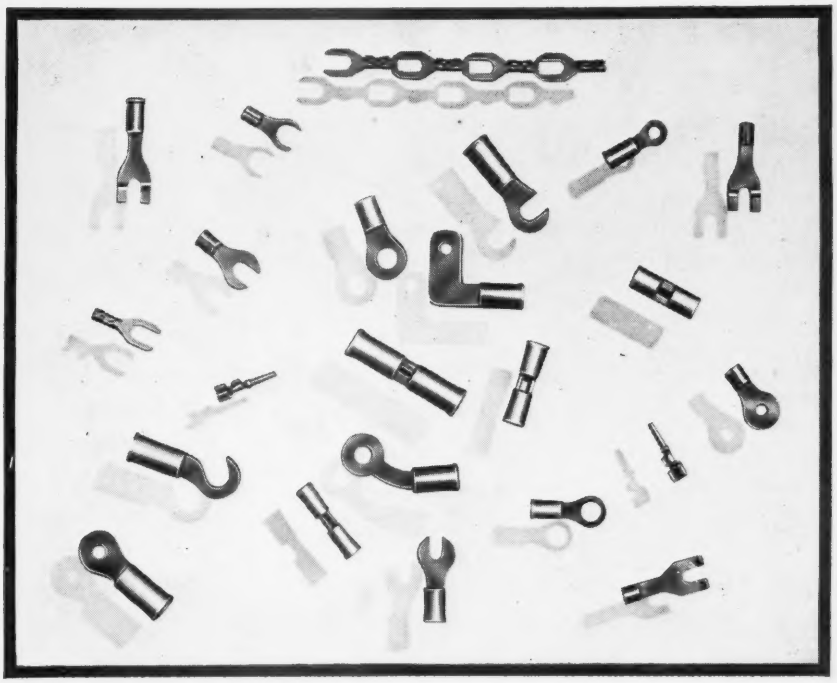

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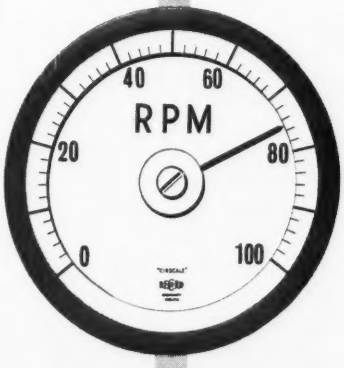

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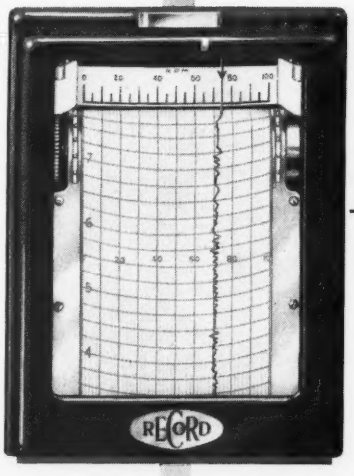

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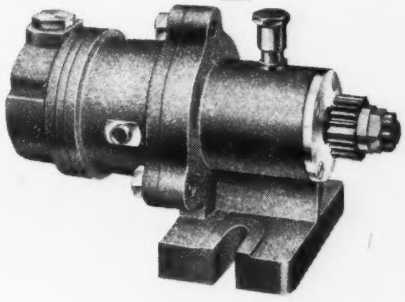

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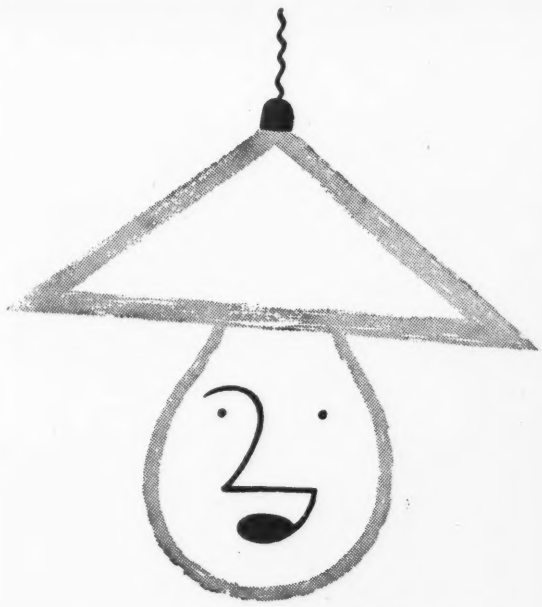

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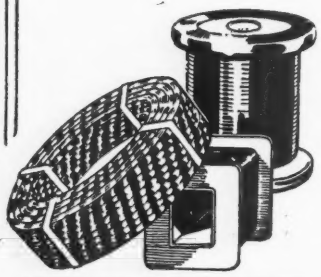

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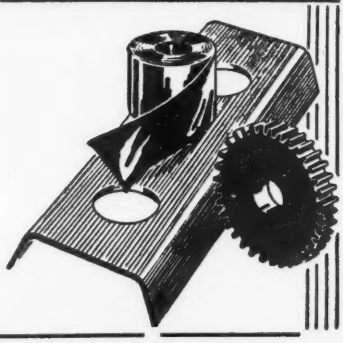

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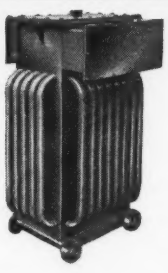

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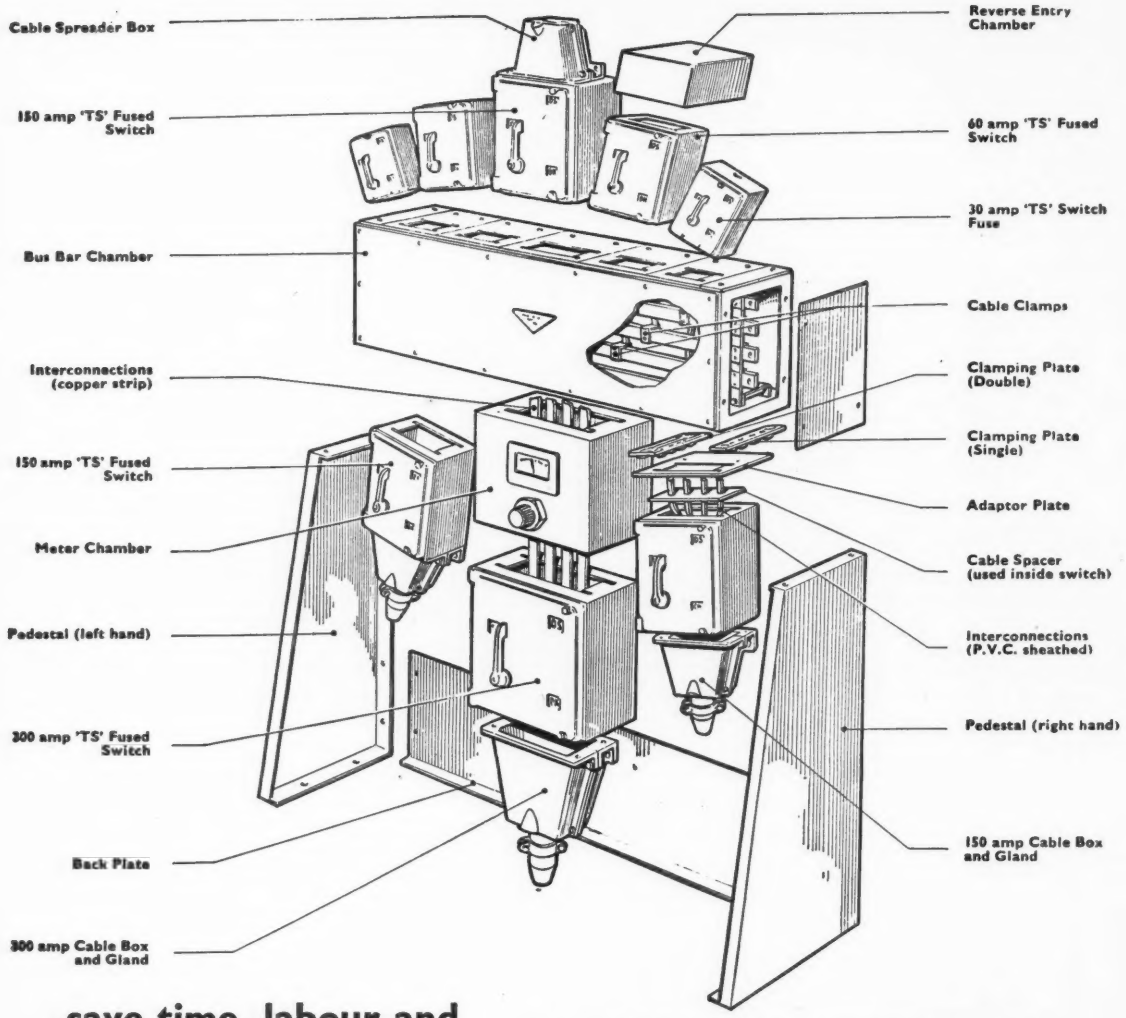

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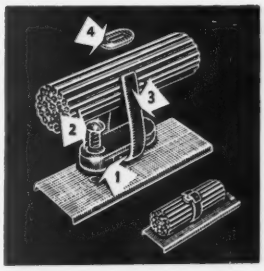

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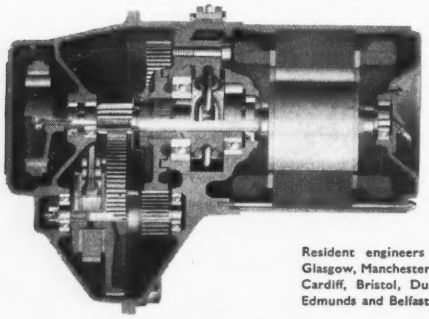

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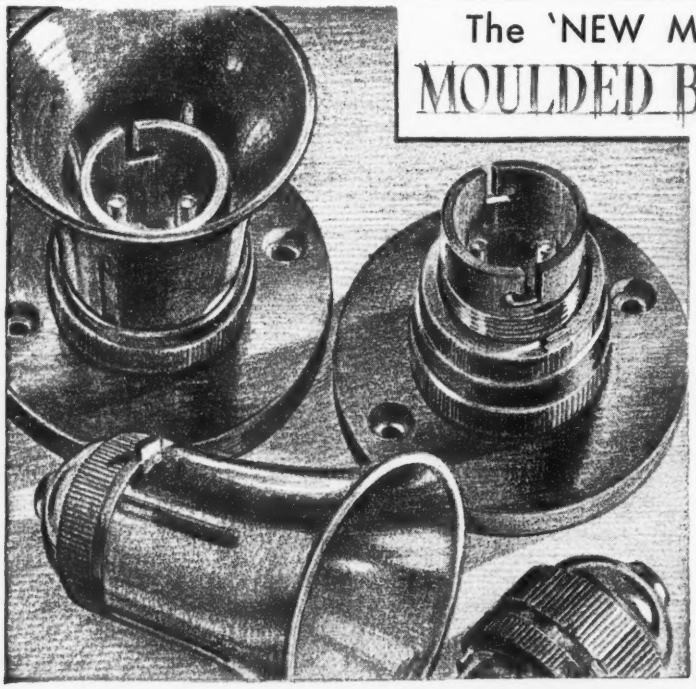

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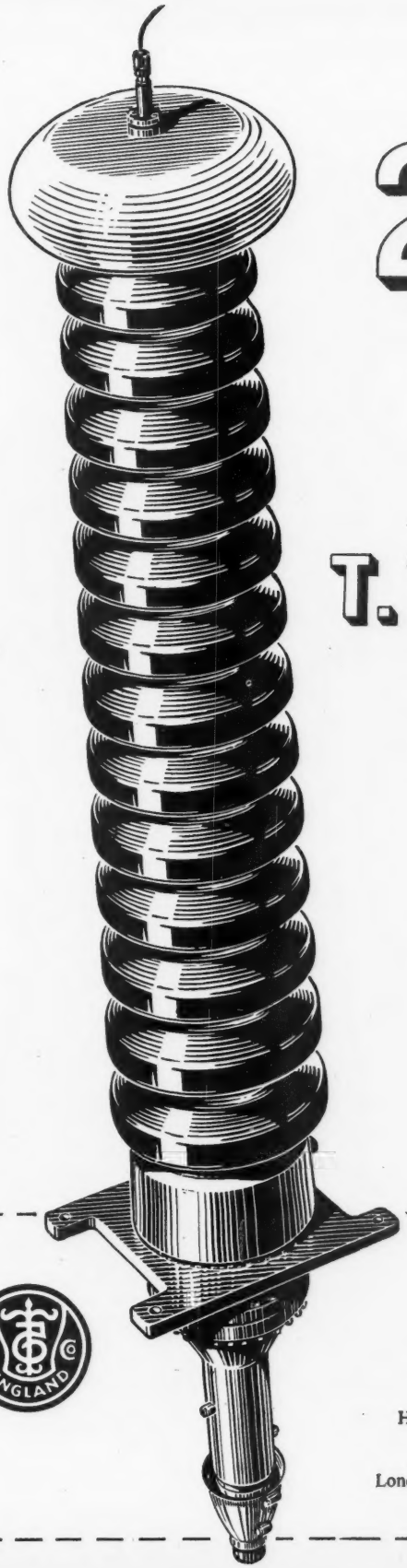

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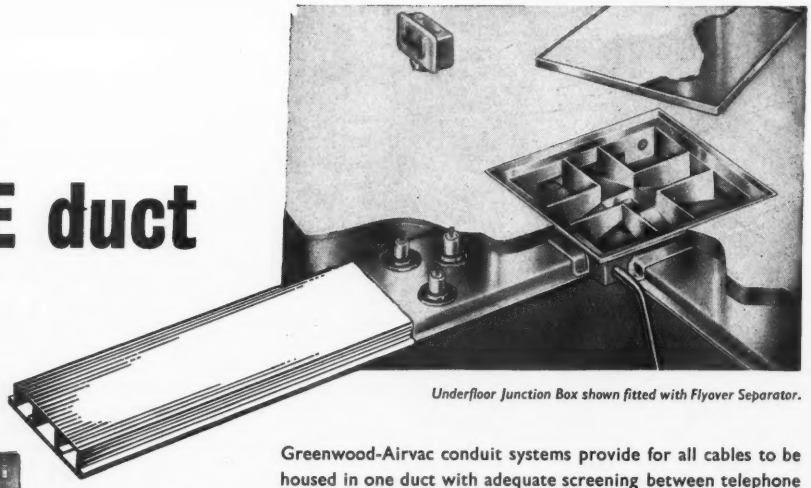

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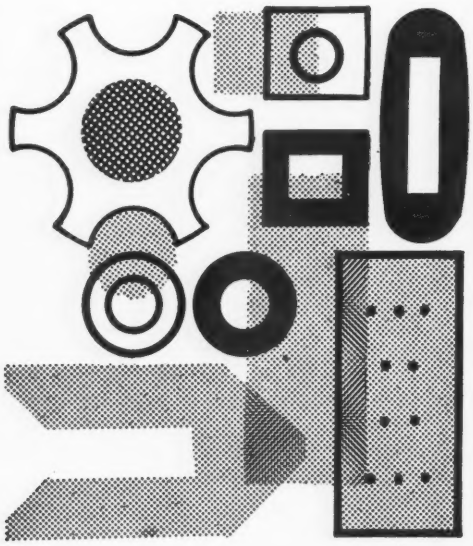

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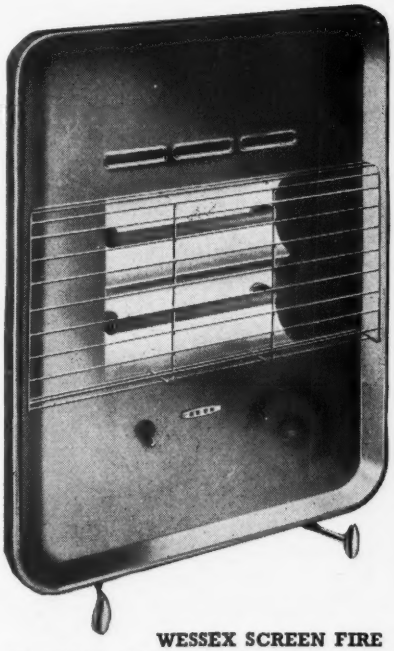

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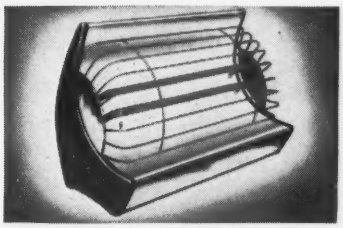
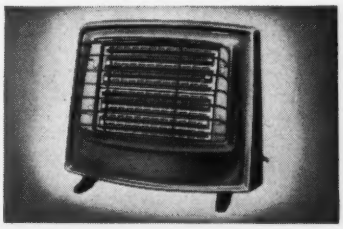
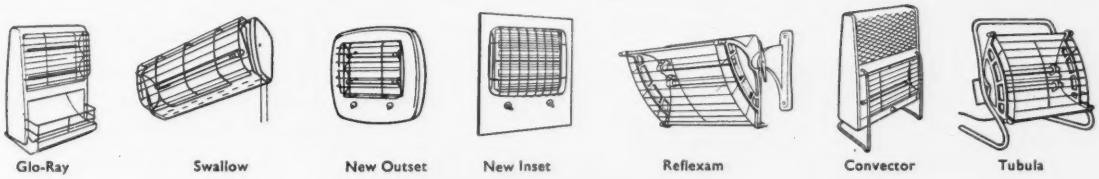


CRESCENT. Delightfully shaped model in enamelled sheet steel with electro-brightened anodised reflector, plated guard and pencil type elements 1 kw. or 2 kw. Colours: Welsh Grey, Cotswold Stone, Pale Gold, Gay Red.



SOMERSET. A fire with superb finish and sound construction. Gleaming vitreous enamel finish with plated guard and block type elements. 1 k.w. or 2 k.w. Colours: Oyster Grey, Guardsman Red, Citron Yellow, Willow Green.



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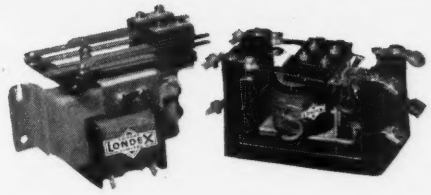

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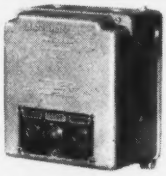

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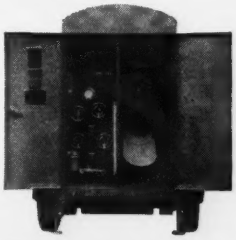

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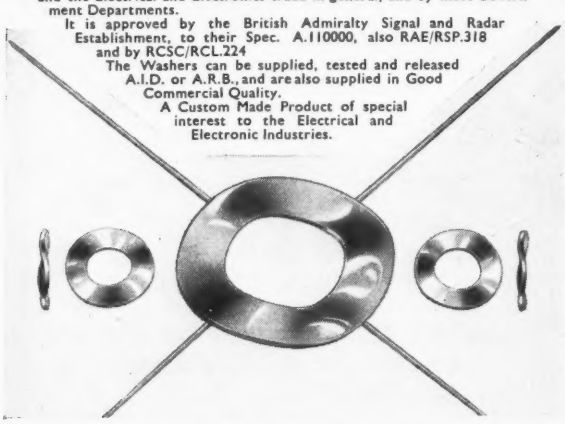

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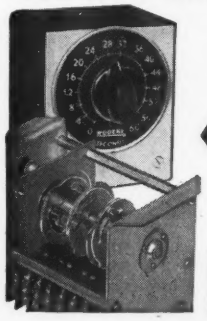

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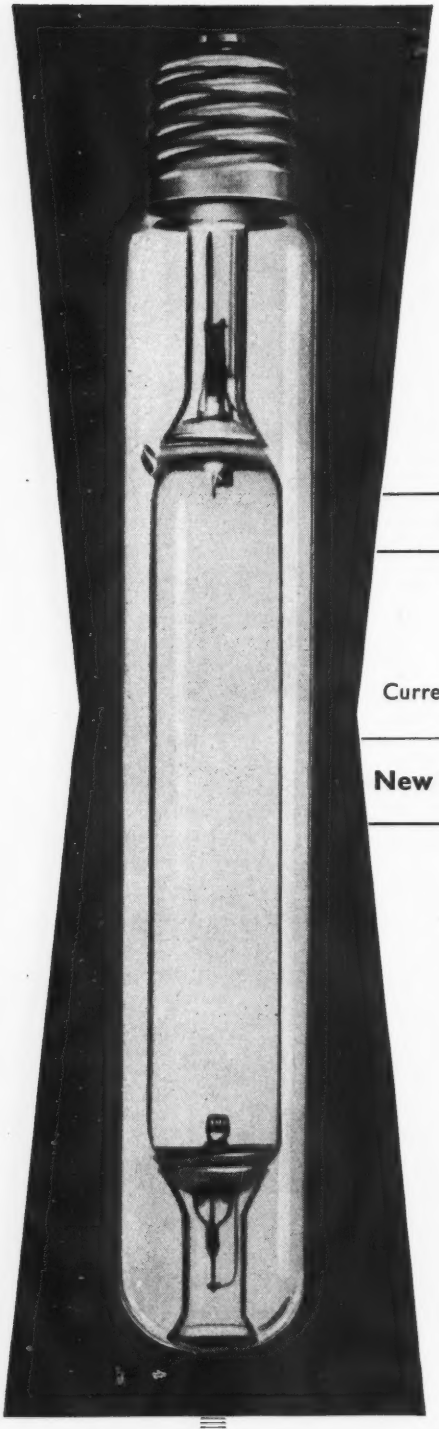

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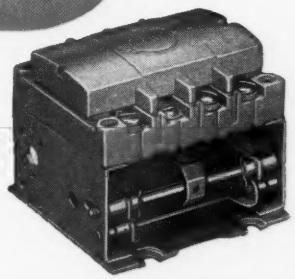

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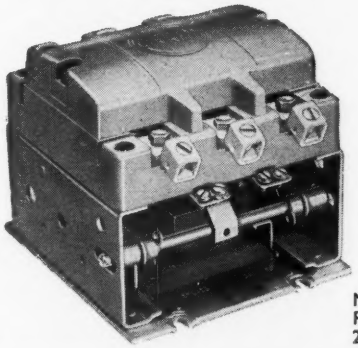

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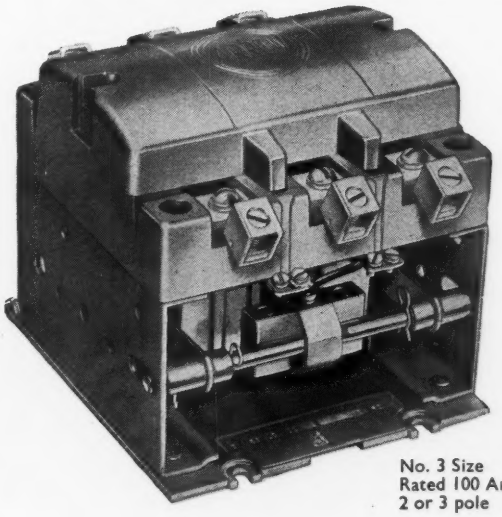

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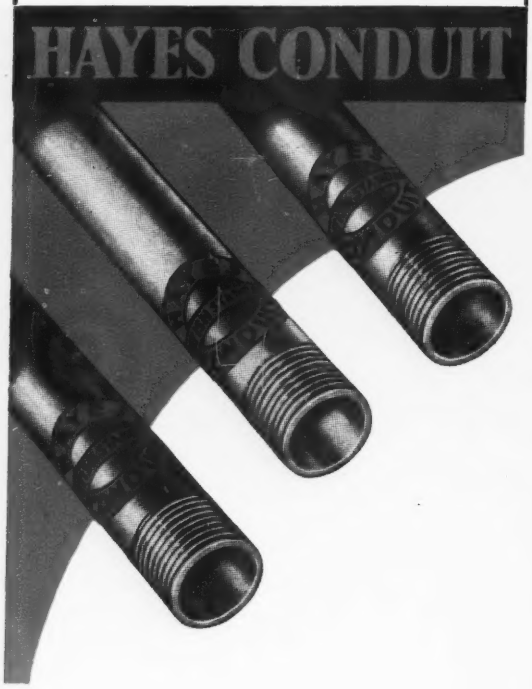

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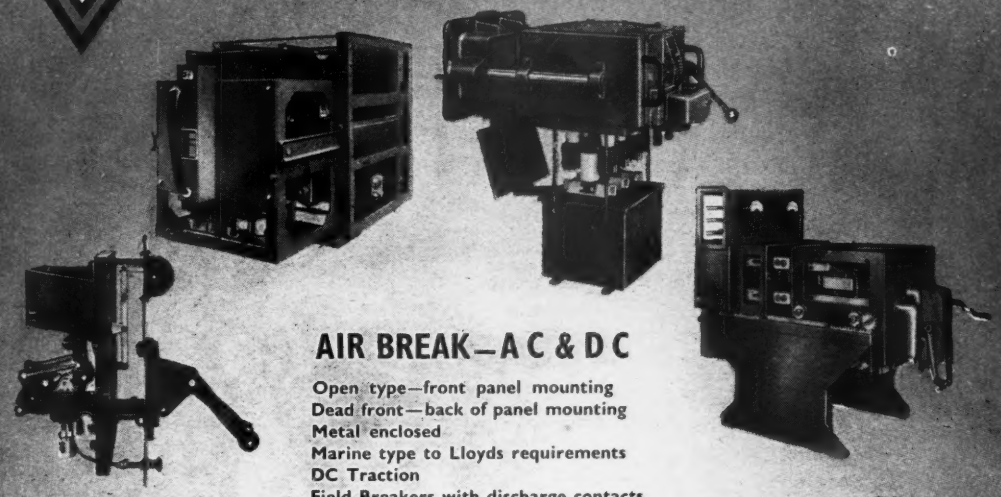

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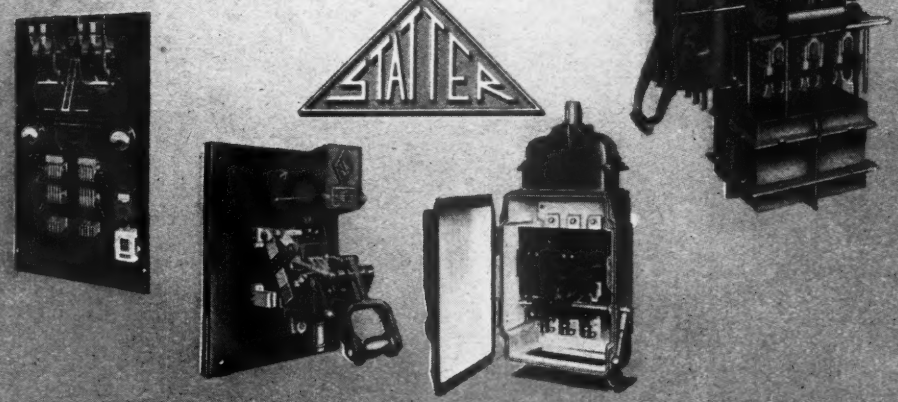

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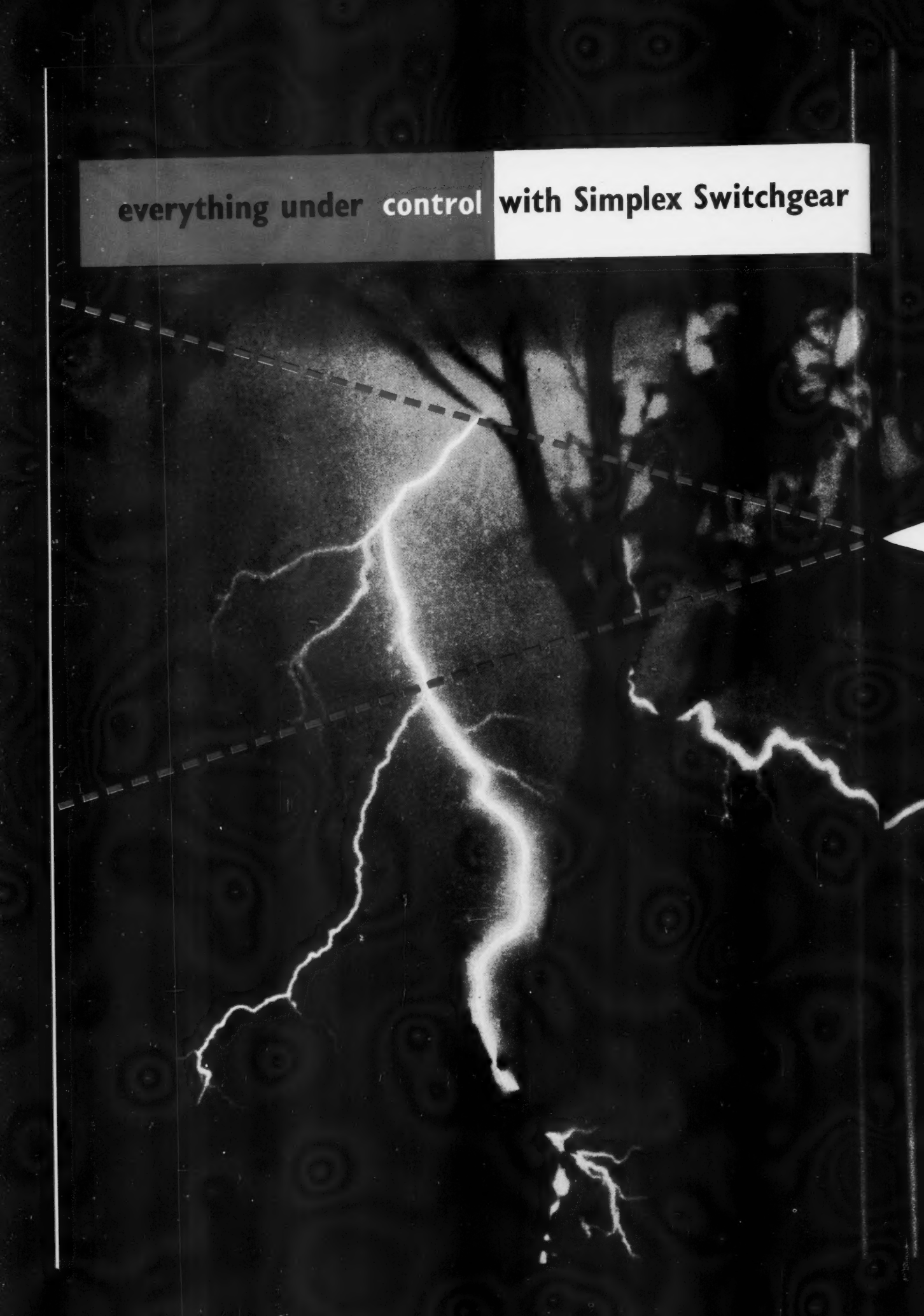
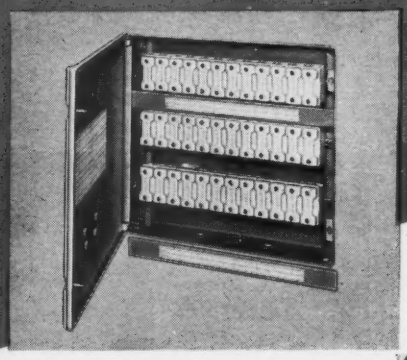

everything under control with Simplex Switchgear

ELECTRICAL REVIEW 27 DECEMBER 1957

Lightning

Meteorology comes within the scope of the observations of scientists of more than 50 nations throughout the International Geophysical Year.



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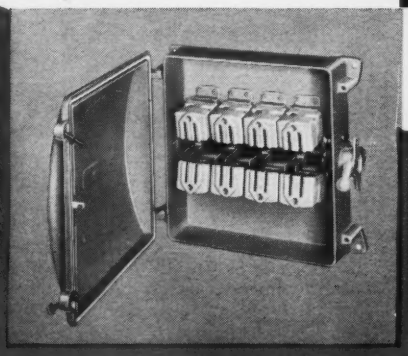

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cut costs and specify

switch and fuse gear by

Simplex

Simplex Electric Co Ltd Oldbury Birmingham

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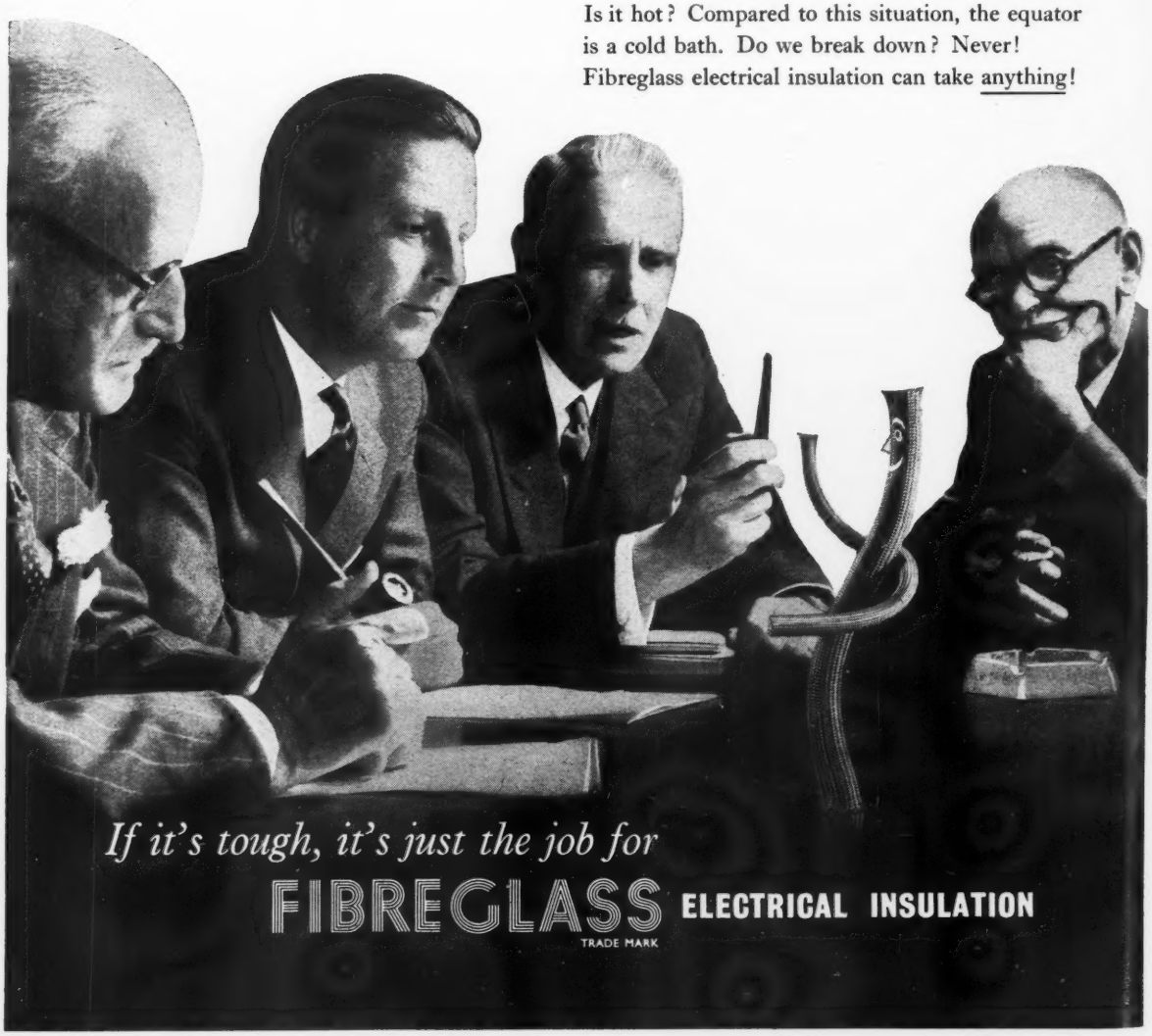

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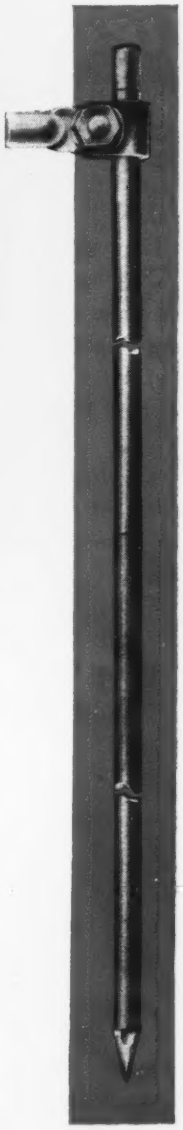

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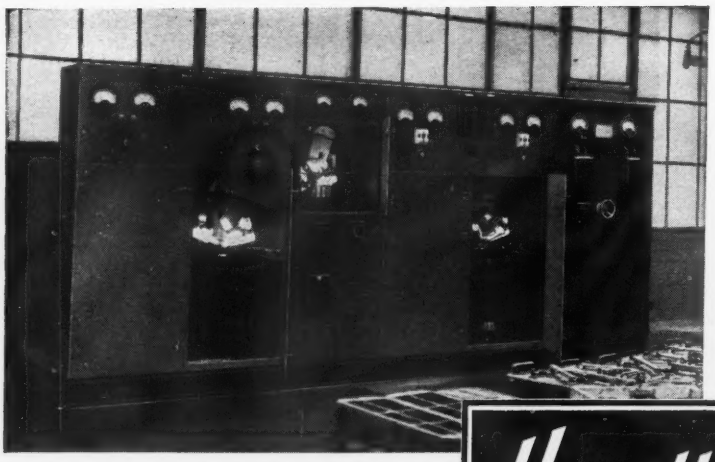

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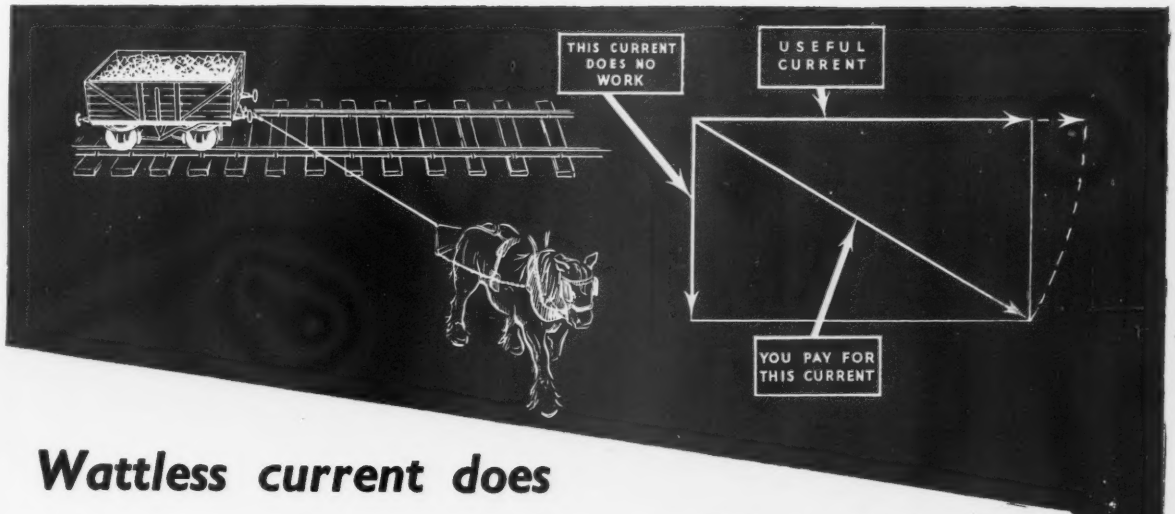

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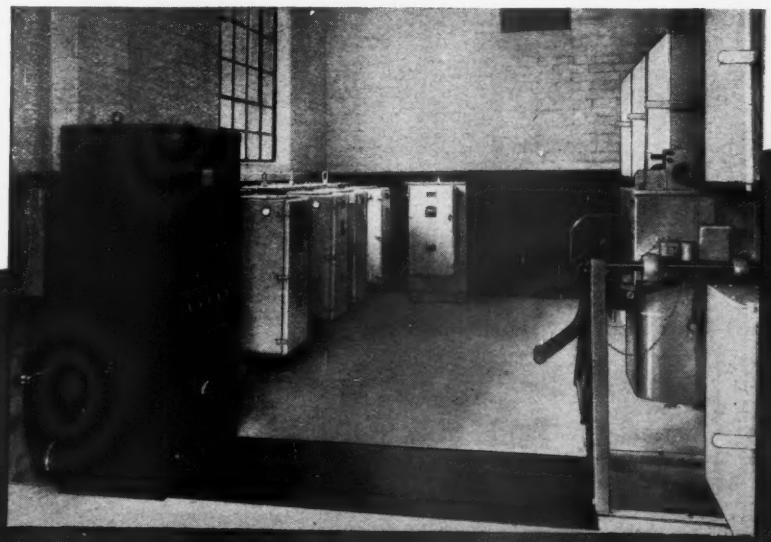

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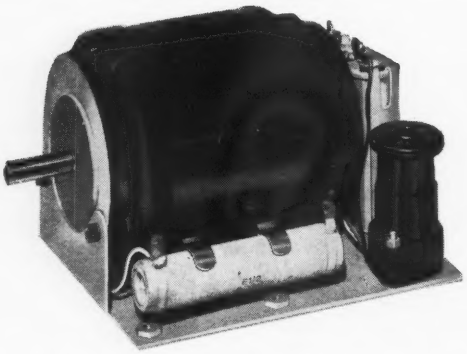

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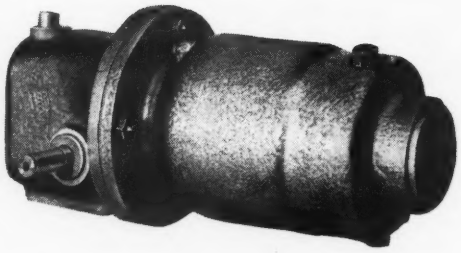

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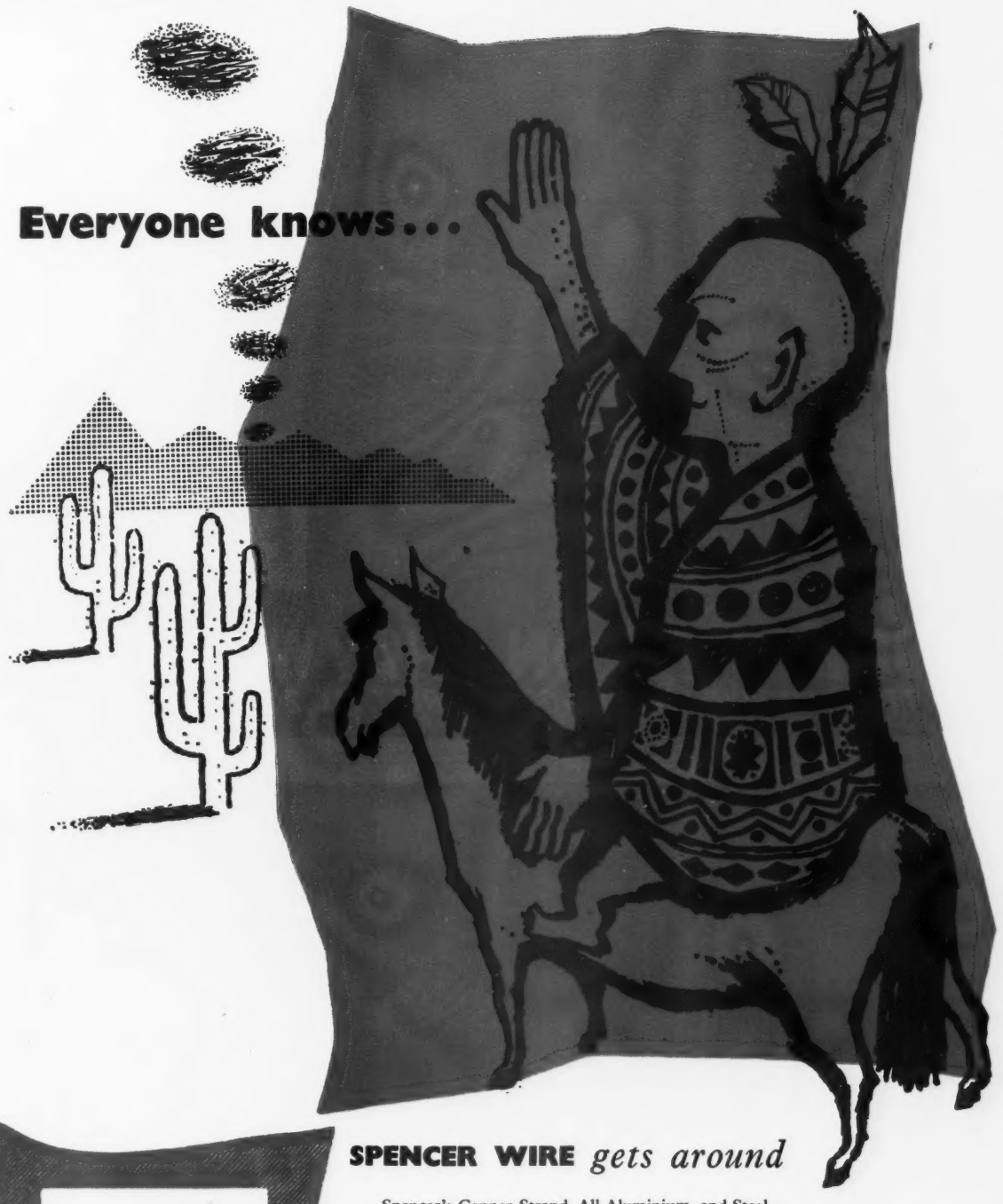

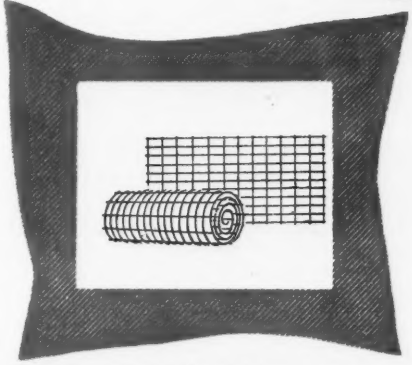

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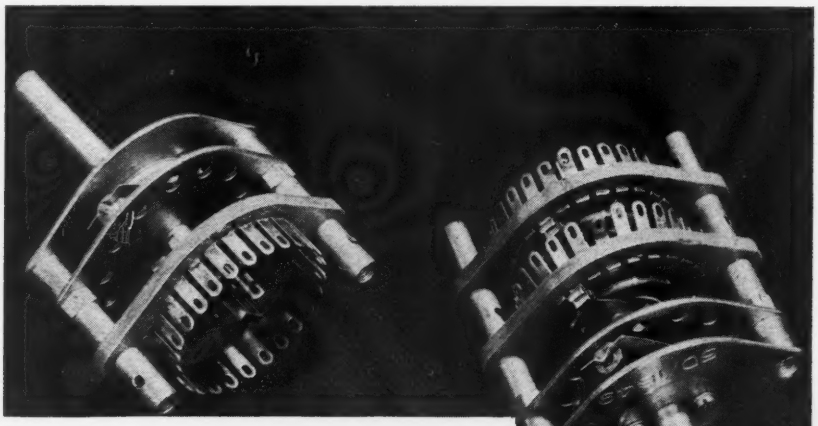

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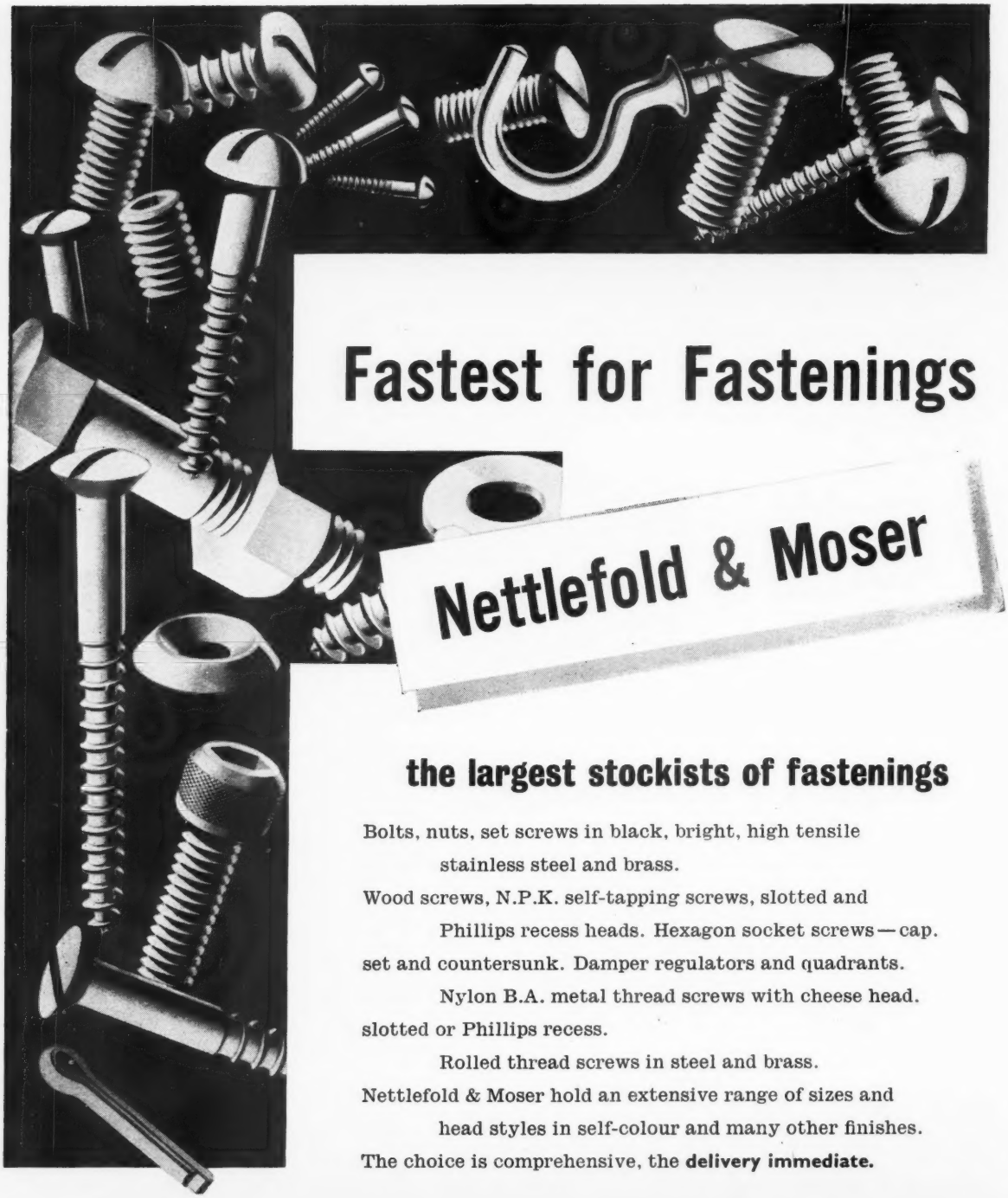

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27 DECEMBER 1957

ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E. *General Editor:* J. H. COSENS *Technical Editor:* P. W. TUCKER, M.I.E.E.

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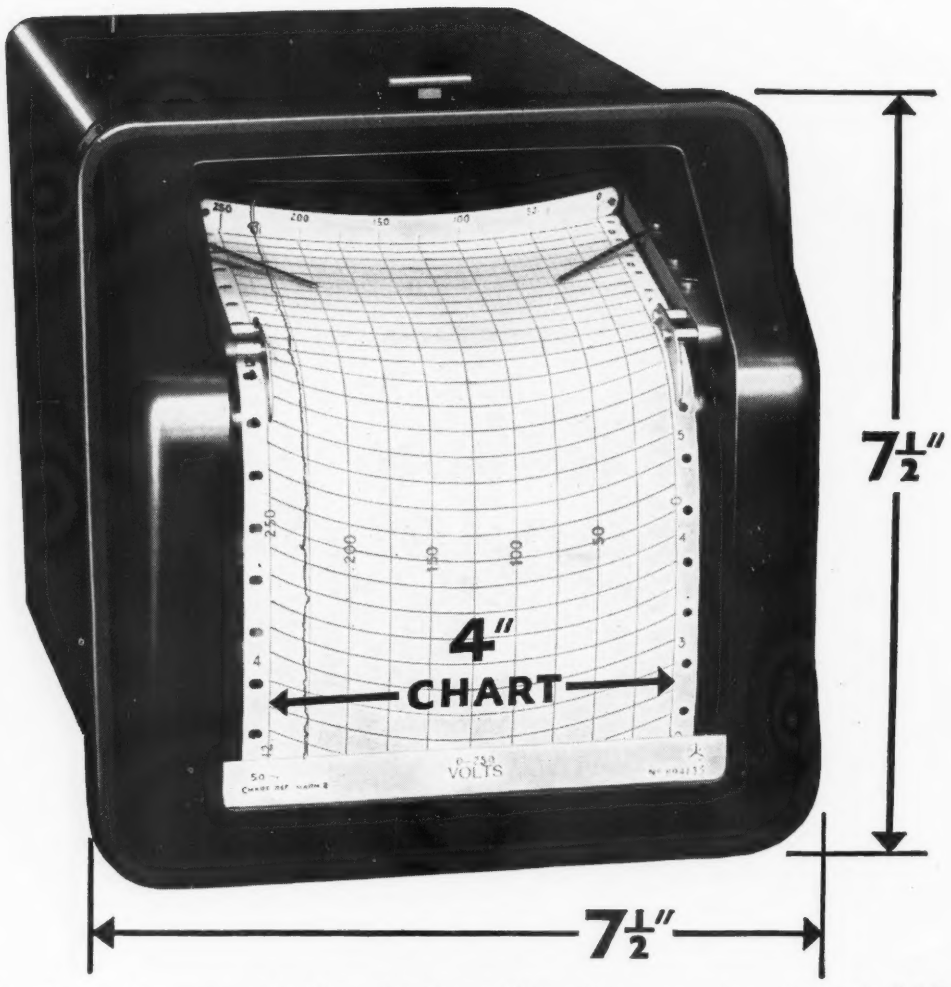

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ELECTRICAL REVIEW

27 December 1957 Vol. 161 No. 26 Established 1872

The Student Paradox

DESPITE the persistently voiced need for many more entrants into the electrical industry who possess good technological qualifications, what appears to be an alarming position is revealed in the Foreword in the November issue of the Journal of the Institution of Electrical Engineers. There it is stated that an increase of one-third in the total membership of the I.E.E. has occurred during the past decade and this is gratifying, but unfortunately it is offset by a drop of more than half in the number of student members. Mr. A. R. Cooper, the author of the Foreword, in discussing possible causes of this seeming paradox, mentions that a suggestion has been advanced attributing the decrease in student members to competing activities, including local engineering societies and " of course, television."

It would seem that the distinction of student membership of the Institution is losing its appeal and this can only be explained under two possible heads, either that the electrical student feels that he gains little for himself from a period of student membership, or that he is not prepared to devote the necessary time to student activities. Some new incentive to student membership might be devised. A term of active student membership might be considered as a justification for shortening the period of responsibility requisite before transferring to corporate membership. Some such inducement seems a reasonable proposition and should help to attract an active membership.

As we see it, the most serious implication may be that corporate membership of the Institution of Electrical Engineers is coming to be looked upon as conveying no more than a qualification necessary to a successful career in the electrical industry, just as a degree in science might be regarded. Other activities of the Institution would appear to be dismissed as unimportant, which receives some confirmation if one considers the comparatively small percentage of the total membership attending meetings and the various functions.

If the bulk of those who aspire to corporate membership, or those who graduate by sitting for the examination, regard membership as a necessary qualification and little else, then something is wrong with those young men who are looking to the electrical industry as a career. The Institution has much more to offer than merely evidence of a technical qualification, and if interest in student membership continues to flag a very thorough investigation into the causes would seem to be called for, both in the interests of the Institution itself and of the new generation of electrical engineers

who are to hold the responsible positions of the future. Mr. Cooper concludes his remarks by saying: "It is vital to the healthy growth of the Institution that this problem should be tackled seriously, and without delay, by senior members in London, the local centres and overseas." With this conclusion we are in strong agreement.

SELLING TO CANADA

That the members of the Canadian Trade Mission should have had to come to this country to be made aware of many of our scientific and industrial achievements is in itself an indication of the extent of the failure to "sell" Britain and British industry in Canada. Although much impressed by the quality of our goods, by their competitive prices compared with their equivalents from the United States and by the efficiency of our manufacturing practices, the members of the Mission repeated some familiar criticisms. Delivery periods are too long; there is inadequate salesmanship and publicity; too few visits by senior executives; and a lack of attention to local tastes and standards.

But, unlike most critics, they also made some practical suggestions that should be of considerable help to British firms, and especially the smaller and medium-sized ones, who are considering entering the Canadian market. Since increased British imports will enable Canada to reduce her growing trade deficit with the United States, measures have also been announced for facilitating British sales to Canada. In particular, Government and other official purchasing is to be examined to give British manufacturers preference wherever possible over existing sources of imports.

Many British firms and products are already well established in Canada. With the new opportunities and facilities offered as a result of the Mission's visit more firms should now make an effort to enter the Canadian market.

STANDARD POWER STATIONS

Considerable immediate economies can no doubt be secured, especially if speedy construction is necessary, as a result of quantity production of standard generating units. It is debatable, however, whether the advantages to be gained in this way are not offset by failure to obtain the full benefits of possible early advances in steam pressures and temperatures as well as in using larger MW ratings. However, Mr. J. Pimpaneau in his I.E.E. paper, reported in this issue, showed how much importance is attached by Electricité de France to research in this subject and that the bulk orders put in hand for standard sets of 115 MW and their auxiliaries apply only to those to be installed during the coming three or four years. Actually units of 250 MW are being put in hand.

DIESEL-ELECTRIC TRACTION

The excellent results achieved in the U.S.A. by substituting diesel-electric for steam locomotives, as shown by Mr. H. G. McClean in the paper he gave before the Institution of Locomotive Engineers, augurs well for the success of a first step in modernising the British railways, even though conditions are so markedly different. Oil is plentiful and comparatively inexpensive in the United States but so is coal, thereby making more apparent the economic as well as the technical merits of the diesel-electric system.

Despite the immense distances generally between stopping points, electric transmission from the engine to the wheels is adopted instead of mechanical gearing. The magnitude of these distances prevents the taking of electricity from a counterpart of the British grid with its associated power stations burning low-grade coal, which is the ultimate aim for the conditions prevailing here.

RUSSIAN UNDERGROUND GASIFICATION

The recent visit of British underground coal gasification experts to Russia, referred to in this issue, has been most successful, and the discussions took place in a cheerful and frank atmosphere. The protagonists of underground gasification in the U.S.S.R. appear to be supremely confident. Their economic surveys show that, in Russian conditions, the heat in coal can be supplied more cheaply to a power station by means of underground gasification than by conventional or opencast mining or by the new method of mining coal with high-pressure water jets and hydraulic conveying. Their system of organisation, from the Academy of Sciences down to the coalfield, encourages interchange of staff and speedy application of laboratory work.

The visit has yielded material which will take some time to digest and to consider in its possible application to the quite different British conditions. The return visit to Great Britain of a Russian party in March should strengthen the exchange of information which has now taken place.

B.E.P.C. EXHIBITION

As we have strongly advocated the retention of the exhibition which is arranged in connection with the British Electrical Power Convention, we are naturally gratified that it has now been decided to hold an exhibition at next year's Brighton Convention. Our gratification will be shared by many exhibitors who regard the exhibition as a link between them and the delegates which it would be detrimental to both the industry and the Convention to break. Incidentally, the exhibition also draws public attention to the Convention and industry.

As the commercial success of the exhibition depends largely upon the interest taken in it by the Electricity Boards, it is to be hoped that the Boards will arrange for as many of their commercial people, as well as their engineers, to pay a visit to the display whether they are Convention delegates or not.

On 1st January the electricity supply industry enters a new phase under the management of the Electricity Council and the Central Electricity Generating Board. Next week's issue will contain a review of the first ten years of nationalisation and an appreciation of Lord Citrine, with a portrait in colour. The new regime will also be outlined.

Steelworks Supply and Distribution

By J. E. McCARTNEY

MODERN PROBLEMS ASSOCIATED WITH PRIVATE GENERATION AND PUBLIC SUPPLY

IN the steel industry a very large number of products are made by a number of different processes, and consequently the plant used varies from one steelworks to another. In general a steelworks consists of two main parts, the melting shop where steel is made and cast into ingots and one or more rolling mills where the variously shaped products are rolled. The demand for electrical power differs greatly in these two parts, and problems of distribution are also widely different.

The majority of modern melting shops produce steel by the basic open-hearth process, in which pig iron, steel scrap and limestone are melted and refined in a regenerative furnace using gas or oil for heating. Pumps for cooling water, fans for handling the furnace gases, feed pumps for waste-heat boilers and various motors controlling furnace doors and dampers form the furnace load. Additional power is required for the overhead cranes handling raw materials or hot metal. In general, the melting shop demand is steady, unlike that of the rolling mills.

The outstanding characteristic of, for example, a reversing rolling mill handling heavy products, such as plates, is the fluctuating nature of the load, which may vary from zero to 25,000 h.p. Although these mills are driven through Ilgner convertor sets, by which energy is stored in flywheels to reduce the peak demands on the supply system, fluctuations of 2 to 6 MW are still normal. The auxiliary equipment associated with rolling mills forms a similarly peaky load.

The nature of the energy requirements of the works is determined by the amount of melting shop and heavy rolling plant installed, but a typical example might be a maximum demand of 15 MW and an energy consumption of 75 million kWh per annum. Where electric furnaces are installed, the ratio of the maximum to the average number of kWh may be increased from 1·75 to 3, and the problem of supply is made particularly difficult. In all cases the power factor of the load is poor, and considerable savings can be made by the installation of correction capacitors.

In general, dirty and cramped conditions are found everywhere, and only in recent years has it been possible to install distribution switchgear in properly designed buildings. Because of the continuous operation of the plant and the dispersed layout of switchgear, it is difficult to ensure that high-voltage and other important items of switchgear are operated only by skilled personnel. Also, maintenance may not receive the same careful and regular attention as in power station or mains distribution practice.

Waste-Heat Generation and Supply

In a modern steelworks, the recovery of waste heat from the exhaust gases of the melting furnaces is an important factor in economic production. Furnaces varying in capacity from 60 to 200 tons are fitted with waste-heat boilers producing some 30,000 lb/hr at around 200 lb/sq in and 600 deg F. Modern developments, which include the fitting of economisers and superheaters, can increase the output and working temperature considerably without adverse effect on furnace operation. When rolling mills were normally driven by steam engines, the quantity of steam produced from waste heat was easily utilised in

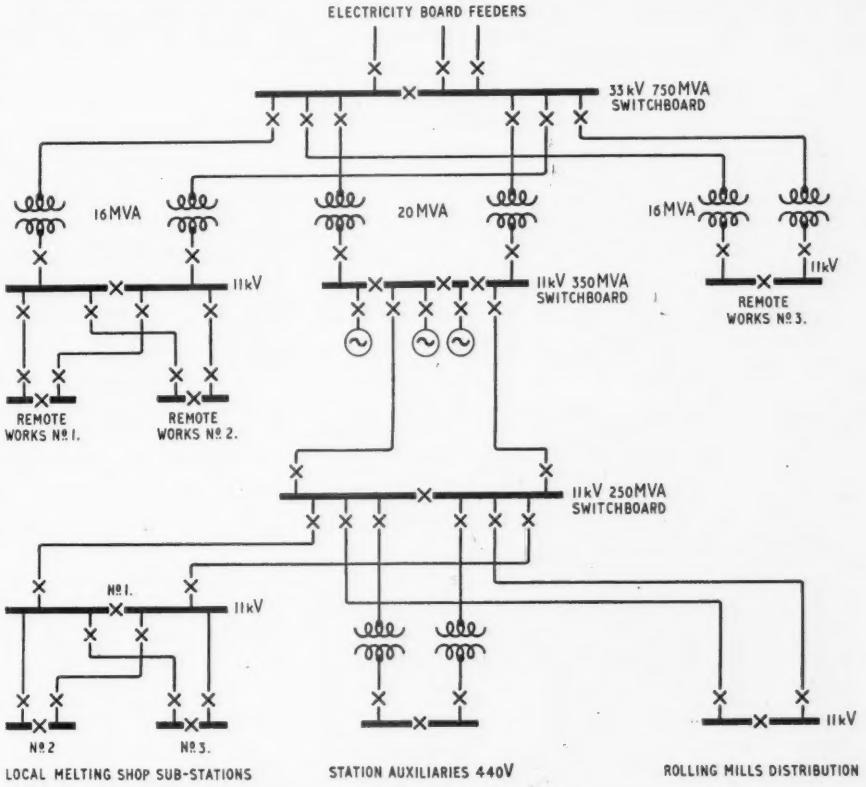


Fig. 1.—Primary high-voltage distribution system showing internal generating and incoming supply arrangements

the mills. In recent years with the majority of rolling mills electrified, this steam has been used to generate electric power.

Small internal generating plants have always been a feature of steelworks power supply, the exhaust steam from rolling mill engines being used in mixed-pressure turbines. High - pressure steam was supplied by waste-heat or fuel boilers, and very often power was generated for use in a d.c. three-wire system. With the reduction in the quantity of exhaust steam available and the introduction of a high-voltage a.c. distribution system, the waste-heat steam is sometimes used to drive an alternator in parallel with the Electricity Board supply. This practice makes the best use of the fluctuating supply of waste-heat steam and also allows the alternator to run with a steady load. Control of alternators under these conditions becomes much more complicated than with a self-contained system and problems associated with the protection of the system against incorrect paralleling and the reverse feeding of fault current into the system must first be solved.

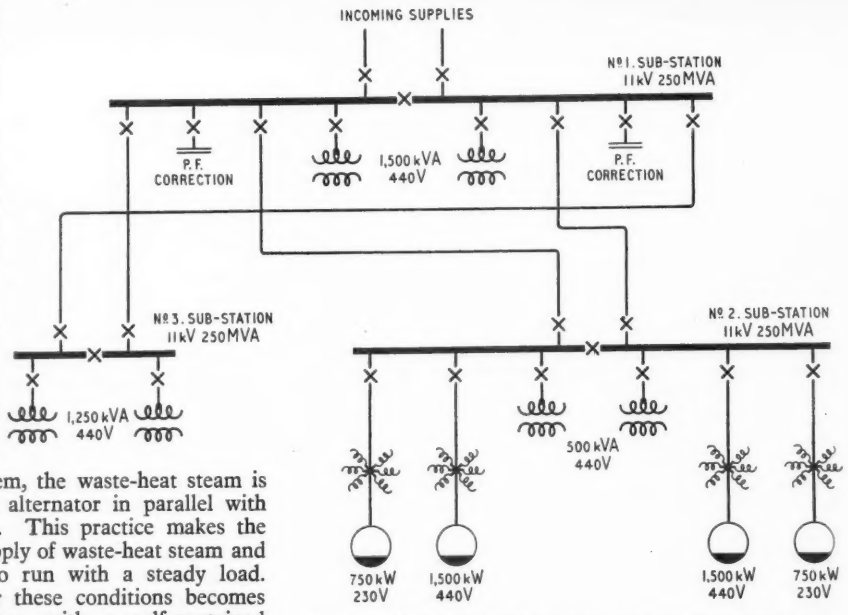


Fig. 2.—Melting shop distribution with step-down transformers and rectifiers

High-Voltage Distribution

The high-voltage distribution system of a steelworks must be designed primarily for continuity of supply. Particularly is this so in a melting shop, where interruption of supply for more than a few minutes will cause very expensive damage to furnaces, and it is, therefore, essential that alternative sources of supply shall be available. The system should also be of ample capacity and of a flexible form so that additional loads due to large items of plant can be easily supplied. Simplicity of operation is a most important consideration in designing the system. Unnecessary interconnections should be avoided since, under emergency conditions, personnel without specialised knowledge of switchgear operations may be required to open and close switches.

The distribution voltage is determined by the sizes and types of loads, the distances involved, the amount of power imported and the voltage of the local mains system. The highly fluctuating nature of the power demand of electric furnaces may affect adversely the local distribution network, in which case the normal 11 kV or 6·6 kV system is not used and a 33 kV or higher voltage supply is brought in from the nearest available point. Steelworks which cover very large areas may also have primary distribution systems at 33 kV or even 132 kV, as in the case of the interconnection of several works separated by long distances, but the voltages most generally adopted are 11 and 6·6 kV, both of which are suitable for the direct connection of alternators and large motors.

Fig. 3.—Oil and compound insulated high-voltage double-busbar switchboard

The increase in demand due to electrification of steam-driven plant, greater production with existing plant or simply improved amenities within the works result in an increase in the capacities of supply feeders. The attendant rise in the value of available fault energy and the addition of parallel-running alternators is likely to make the rupturing capacity of existing switchgear inadequate, necessitating its replacement or alteration or else the installation of current-limiting reactors. The former alternative may prove a formidable undertaking since alterations must be carried out without serious discontinuity of supply. On the other hand, some of the older switches may well have assigned ratings so low that the size of reactors required would be uneconomically large.

The layout of the systems in steelworks will differ greatly, depending on the loading, the distances involved, the age of the installation and local preferences. The principal requirements are, however, the same. The first consideration is the maintenance of supply and, for this reason, more than one supply is normally brought into the works, even when local generation can be considered as standby. The supply to each load centre must also be duplicated, and it is a great advantage to be able to parallel these supplies, so that routine maintenance shutdowns can be effected without discontinuity.

Large steelworks cover a considerable area and require a number of substations for adequate distribution. The staff available for operation and maintenance is, however, neither so numerous nor so specialised as in an equivalent supply authority area. For this reason, it is essential that the system be as simple as possible. Centralised control

of the system is also difficult to achieve, and this calls for special care to ensure that mal-operation is avoided. Because of the complexity of its protection and operation, the ring-main system which forms the basis of most supply authority distribution is not widely used. Modern practice favours the installation of duplicate radial feeders to each load centre. Liberally rated, these connect to either side of a split busbar which can be coupled by a section switch, allowing the total load to be fed by one cable in the event of failure of the other. For simplicity, it is usual to operate the system with a minimum of protection. Earth-leakage and overload protection using inverse-time lag, definite minimum type relays and Buchholz transformer protection are the only commonly used items.

Owing to new production methods, changing markets and deterioration of plant, there are continual changes in the quantities and locations of power demands. The distribution system must be sufficiently flexible to deal with these alterations without overloading or major reorganisation. Similarly, the upward trend of the demand curve makes it desirable to install switchgear and cables with as much spare capacity as is economically possible.

Like the system itself the switchgear used in steelworks distribution must be safe, reliable and simple to operate and maintain. It must, in addition, take up a minimum of space and be easily erected. The switchgear generally adopted is of the metalclad truck type with either air or oil and compound insulation. This type of switchgear is safe and simple to operate, and can be fitted with a variety of operating mechanisms. Its total enclosure protects it from dust and vermin while switchboards can be built and added to easily. High-voltage switchgear for use on systems with available fault energy greater than 250 MVA should be fitted with automatic closing

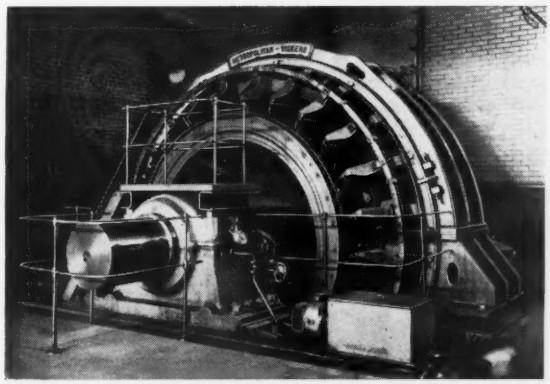


Fig. 4.—Cogging-mill motor, 15,000 peak horse power

to ensure that the switch makes sufficiently rapidly in the event of closing on to a fault. This can be done by the energy of a charged spring released by hand or by an electrical circuit or by solenoid. If either of the remotely operated methods is used, centralised control of the switchgear becomes possible. This offers considerable operating advantages, particularly in emergency.

High-voltage switchgear controlling mill drives presents no difficulty regarding its location, since an Ilgner station or other control room is required and the switches can conveniently be installed there at the load centre. On the other hand, where the load consists of melting shop or mill auxiliary equipment, the placing of such switches often creates a problem of considerable difficulty. The aim here is to bring the h.v. supply as close as possible to the load centre to minimise l.v. distribution losses, but this may conflict with requirements of plant space, and often a substation has to be situated further away than is desirable from that point of view. Owing to mill dust the cleanliness of areas close to rolling mill or melting shop also leaves much to be desired for h.v. switchgear. In very bad cases it may be necessary to obtain a supply of ventilating air either from a cleaner area or through filters.

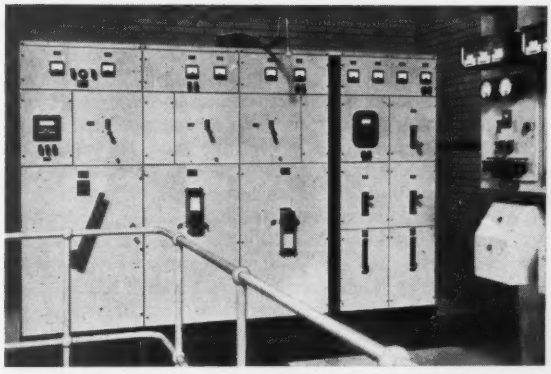
Low-Voltage A.C. Distribution

The scope for a low-voltage a.c. distribution system in steelworks has widened greatly within the last two decades although there are still plants in existence with all d.c. distribution. With the electrification of rolling mills and the development of h.v. distribution, the advantages of the former have been recognised for such constant-speed drives as water, fuel and hydraulic pumps, air compressors and certain fans. In the melting shop, waste-heat boiler fans for inducing variable draught in the furnaces have had their variable-speed d.c. motors replaced by variable- or two-speed a.c. motors. In the latter case fine control of draught has been achieved by vane control at the fans. Forced draught fans, valve reversing gear, furnace-door motors and boiler feed pumps are now generally fed from the three-phase, 415 V system. High-bay mercury-vapour or other lighting also requires 240 or 415 V a.c. supplies. Travelling cranes and mill auxiliaries are still very largely operated by d.c., but here, too, some advances have been made by a.c. equipment.

At first, when few transformers were installed in the works, the distribution system consisted of overhead or underground cables connecting them to any points at which an a.c. supply was required. Connections were quite often made to overhead distribution lines without any protection. Neutrals borrowed from a different circuit or even from earthed metal were not uncommon. Even to-day, the growth of the load takes place in such a way that a rational, easily operated and fully protected system is difficult to develop from this original skeleton network.

New substations are usually laid down to supply a considerable quantity of power to new items of plant. If the substation is sited as near as possible to the load centre of the area and transformers of sufficient capacity are installed, it will be possible gradually to supply the various items of plant through suitably rated and positioned distribution and sub-distribution boards. A problem which arises if the power required is large is the level of

Fig. 5.—Air-break medium-voltage switchboard



fault energy available on the l.v. distribution boards. For ranges of waste-heat boiler fans or for melting-shop pumping stations, transformers of 1,500 kVA may be required. The available fault energy of a transformer of this size is high, making l.v. switchgear of at least 25 MVA rating necessary, and preventing the operation of transformers in parallel to ensure continuity of supply. Auxiliary feeds must be arranged by sectionalising busbars and by feeding each section by a transformer of capacity sufficient for the complete load. Figure locks or electrical interlocks are required to prevent inadvertent paralleling, but they also prevent the isolation of a section for maintenance without a shut-down.

The l.v. switchgear for main distribution is of a variety of types depending on local conditions and individual preference. A common form of this equipment is the metalclad steel tank oil circuit-breaker with horizontal isolation. Switchboards for distribution circuits and motor starters can be built up easily and additions can be made without trouble. These boards are robust and are safe and simple to operate and maintain. They are often installed above the floor of mill or melting shop.

With the trend toward properly constructed substation buildings, air-break switchgear has come into fairly common use. This type of switchgear solves the problem of fire risk as it has no oil content, but it must be installed in a clean substation. The dead-front air-break switchboard is easily maintained and has a good appearance.

Sub-distribution gear should be located on the mill floor or melting shop furnace floor, but in these places floor or wall space cannot always be found for mounting switchgear, and the complexity of foundations, plant and pipework makes it almost essential to run cables across the roofs. Very often special platforms support this gear above the mill floor or furnace valve pit.

Owing to the need for great flexibility, it is highly desirable that sub-distribution gear be inexpensive and capable of being rapidly modified. In addition, it should be suitable for operation in dusty and moist atmospheres with safety and simplicity. The ranges of industrial switch-fuse gear offered by several manufacturers have been widely used for this duty. Fitted with h.r.c. fuses they can be used for the control of most single- and three-phase circuits and their robust metalclad construction makes them suitable for the difficult conditions under which they must operate. Switchgear can be built up easily from standard comparatively inexpensive quickly obtainable parts, and modifications can easily be made.

D.C. Distribution

The steel industry is one in which a considerable proportion of the power used—some 25 per cent—is in the form of direct current. This is due to the quantity of material to be handled in the form of pig iron, scrap, hot metal, ingots and finished steel. The d.c. motor is still the best form of drive for accelerating, decelerating, transferring and inching these masses by overhead crane or roller tables. Before the electrification of mill drives, these auxiliaries formed the major part of the steelworks load and power generated in the works was distributed as three-wire d.c. from open type slate-mounted d.c. switchboards with knife isolators. The power was very often carried by bare aerial cables fixed to towers supported on the ground or building roofs. The inefficiency and the maintenance difficulties of such a system, particularly in bad weather, brought about a rapid reduction in the extent of its use as soon as high-voltage a.c. distribution became widespread. This form of d.c. distribution is found to-day only in the older steelworks, and is rapidly dying out.

The modern d.c. distribution system consists of a number of comparatively small local rectifier substations supplying the power for cranes and mill auxiliaries in a particular mill or melting shop area. These are fed from the h.v. system, from which distribution is carried out by busbars or underground cables. Of the three major types of rectifier equipment, viz. pump evacuated, pumpless steel tank and glass bulb, the last two are the only ones found in the steel industry owing to the complexity of pumping equipment. The pumpless steel tank and glass bulb types can each claim some advantage over the other.

With the limitation in the use of d.c. and the simplification in its distribution, the three-wire system has been largely replaced by the two-wire. This forces a choice of system voltage between 220 and 250 V or between 400 and 500 V. For general use in mills and melting shops the lower-voltage range is to be preferred since motor powers are moderate and safety is more easily guaranteed. However, with the present-day increase in melting-furnace capacity and the attendant increase in the weight and power requirements of ladle and other melting shop cranes, the lower-voltage range would involve considerable currents and the higher range of voltages is more suitable. A further advantage of the higher voltages is the possibility of using two standard lower-voltage motors in series for hoist and travel motions of larger cranes.

Where several large cranes work together in the same bay peak currents amount to several thousand amperes, requiring a large cross-section of copper. Distribution to the various down-shop conductors is therefore often difficult. Since provision is normally made for the extension of steelworks buildings, it is a common practice to situate the rectifier substation in the centre and to distribute across the building. In a melting shop where there are a number of bays together, a considerable number of cables has to cross the bays. Tunnels in which bare copper busbars can be used are sometimes built across the width of the buildings and cable connections to the crane conductors are led up the building columns.

Direct current mill auxiliaries, which include screwdown drives, roller tables, manipulators and pull-across gear are normally grouped within a small area, and the contactor control gear is housed at a central point and has one or more supplies. The problem in this case is also that of transmitting considerable currents along difficult routes. In this case the mill and roller table foundations as well as conditions of high temperature and considerable moisture have to be overcome. Cable tunnels or ducts built under or through the foundations are almost essential where the position of the rectifiers and contactor houses requires that the line of the mill be crossed.

Modern Developments

A large part of the difficulty of steelworks distribution arises from the layout of the plant, which is cramped and very often built on the foundations of older plants. Sites for substations and other electrical buildings cannot easily be obtained, and underground cable routes are often impossible. In steel plants built in recent years considerable advances have been made due to recognition of the requirements of the electrical system. Buildings have been designed with adequate space for electrical plant, and systems of service ducts with sufficient capacity for present and future cable requirements have been provided. Adequate ventilation ensures, in addition, that the gear operates under the best atmospheric conditions.

Installation Economy

Lighter Wiring and Non-Metallic Conduits

By T. C. GILBERT, M.I.E.E.

THE Rt. Hon. Hugh Molson, Minister of Works, has recently said:—

> "The building industry will feel the effects of these new measures; it is intended that it should. I introduced in April last fixed price tendering in an endeavour to interrupt the vicious spiral of increasing costs and wages in the building industry. The contractor is now expected to carry the risk of increased cost of material or labour in jobs that are completely pre-planned and likely to be completed in two years. The reduction in jobs which will result from the 7 per cent Bank Rate and from the other measures announced last week by the Chancellor of the Exchequer will obviously intensify competition amongst civil engineering contractors and builders and consequently amongst the manufacturers of building materials. I am hopeful that this will keep down the cost of building, but the output need not decline much if there is the necessary increase in efficiency from management and in effort from labour."

Restriction in building must, of course, affect the electrical installation industry; contracts will be fewer and competition keener, so that the Minister's words "efficiency from management and effort from labour" take on a definite meaning and implication for installation contractors. We have by no means reached a high degree of efficiency in installation practice, as the heavy wiring systems employed in large buildings demand too much from both management and labour for the result obtained. They are liable to lead to far too many unproductive hours, which may make all the difference between profit and loss for the contractor. If the number of contracts is to be maintained under present-day conditions their present high cost must be reduced. It is of little use for the industry to fulminate against the "do-it-yourself" man, who, with the aid of periodicals devoted to the activities of the handyman, is taking on more ambitious jobs than hitherto, while professionally-installed wiring costs so much.

The writer suggests that wiring costs can be cut considerably without loss of efficiency or safety—in fact, the reverse—with the adoption of simple modifications in wiring practice. The most important document published since the war, Post-War Building Study No. 11, "Electrical Installations," contained four main proposals for reducing wiring costs, with a view to more adequate installations, especially for post-war housing. It was claimed that their adoption would reduce the cost of small installations by 25 per cent, but of these recommendations so far only three have been generally accepted; these are single-pole fusing, the ring circuit and the consumer's control unit.

Conductor Sizes

The ignored recommendation is that dealing with conductor sizes. Para. 77 of the Study suggests the use of 1/·044 wires for lighting circuits, 7/·029 for the ring circuit and 7/·036 cables for cooker circuits; of these, 7/·029 is universally used for the ring circuit, but it is rare to find 1/·044 in use for lighting circuits or 7/·036 for the cooker, as almost always the larger and more expensive 3/·029 is used for the former purpose and 7/·044 for the latter. The average wiring contractor is inclined to hold up his hands in horror at any suggestion to use 1/·044 conductors in conduits, although at the same time he cheerfully accepts and uses m.i.c.c. systems, in which the conductors are perforce of the solid variety.

It would seem that if allegations of breakage at accessory terminals were well founded that drawback would be clearly demonstrated with m.i.c.c. systems, as the conductors receive much more handling during the sealing and insulating processes than do normal insulated cables. It is pointed out that some very successful underfloor heating cables incorporate a 1/·044 conductor, so we must conclude that objections to the more general use of this economical conductor are based more on prejudice than actual experience.

It cannot be alleged that the reduced loading of 1/·044 compared with 3/·029—Table 12 says 5 A against 10 A, although this must be considered as unduly conservative in view of the fact that with m.i.c.c. systems 1/·044 may be loaded to 16 A—has any serious effect upon final sub-circuit efficiency, as 5 A at 240 V represents quite a lot of lighting. On a current basis no fewer than fifteen 80 W fluorescent lamps could be supplied, and although other considerations will normally reduce this number to half, no final sub-circuit is ever so heavily loaded. In any realistic approach, therefore, it must be conceded that even 1/·044 is unduly extravagant and, if available, a 1/·036 conductor would serve as well.

Conduit Loading

The smaller overall diameter of the solid conductor cable, especially in the p.v.c. or polythene insulated type, takes on an added importance in view of Reg. 218, which restricts the loading of conduits to no more than 40 per cent of the available space. This means that either a greater number of cables may be drawn into any given size of conduit, or, alternatively, a smaller conduit may be used, either way leading to economy in material. All copper, and some steel, has to be imported, and probably anything up to 10 per cent of these materials could be saved on each installation, in the aggregate a not inconsiderable economy. In passing, it might be said that this severe restriction in conduit loading is in itself highly inefficient, and in the writer's view unnecessary, but this is a matter over which the contractor has no control.

The industry is now faced with a further possible increase in operatives' wages, and it is said that this application will be pushed to the limit. It would seem, therefore, that economy in costly man-hours is more important than any possible economy in materials. Under the new conditions electricians, knowing that work is not as plentiful as hitherto, may not put forth their best efforts, and it is necessary to consider means whereby there are not so many reasons for loss of time as at present.

In small houses and similar buildings the wiring systems extensively employed over the past few years have been t.r.s., or its modern equivalent, plastic insulated and sheathed cables, but such flexible systems are not applicable to large public buildings or blocks of flats. In these, the heavy gauge steel conduit system reigns supreme,

demanding a high degree of skill with unremitting attention to such important matters as conduit continuity. Further, these heavy systems make a considerable demand on space and handling in stores, with high costs for transport, for not only are heavy tubes and fittings to be carried but also stand vices, screwing tackle, tube benders and complete tool kits for the installers.

It is therefore surprising that more contractors do not make use of the non-metallic conduit systems, now readily available in the flexible form from several sources, which have been employed with every success in the heaviest types of installations both at home and abroad. The contractor would save himself many serious headaches, and although he is inclined to claim that he has no jurisdiction over the type of installation so often the subject of a specification, the writer has yet to meet the modern architect who would not be prepared to consider some alternative to steel conduit, especially if it showed economy in costs; this will be especially the case with the imposition of the restrictions mentioned at the commencement of this article. However, as these simpler systems are not so well known as they should be, their advantages will be described in some detail.

Condensation Troubles

In the average block of flats the floor construction is such that it is impossible to find adequate drainage falls with long horizontal runs of steel conduit, and this has led in some cases to early failure of conductor insulation by reason of accumulated moisture; usually the flats are required for tenants' occupation long before the building has had any reasonable chance of drying out, with the result that conductors are drawn into wet conduits. Alternatively, the contractor pays for considerable time spent in drawing various things through the conduits to remove the worst of the moisture, but he must often have sleepless nights wondering if the cable breakdown will occur within the guarantee period or balance-of-payment retention time. The condensate has a habit of continuing down vertical conduits into switch and socket-outlet boxes, with the result that the final insulation resistance test is affected, requiring possibly the replacement of some accessories.

With strong-wall flexible non-metallic conduits no serious troubles of this kind need be feared; however long and tortuous the underfloor run there will be no lakes in the valleys due to condensation. If by any chance some moisture has entered the conduit it will not become rusty, and will dry out without affecting the plastic insulated conductor. The saving in labour is two-fold, as long lengths of plastic conduit may be run from point to point as easily as a coil of rope, with the minimum of effort, as no threading or fitting is required in the longest run. The second reason is possibly more important, as there is now no need for the wireman to concentrate upon adequate continuity, or discuss with his mate whether the last length installed should be taken out again and a locknut fitted; he probably knows by now that its omission may lead to later trouble in these days of heavy-current loop tests and independent inspection.

As is well known, for those points in plastic conduit requiring an earth continuity conductor a bare copper conductor is drawn in with the circuit wiring, but as this practice is also becoming common amongst contractors who are inclined to distrust the permanent continuity of screwed or grip joints, the additional cost can be considered as negligible. There is no risk of inadequate continuity with this simple method and it needs only the hour or two saved in loop testing, or possibly the several hours spent in tracing the doubtful joint or joints, to more than pay for the additional copper earth conductor.

In transport, too, many savings are possible, as the light and compact coils of conduit mean that either much more material can be carried for the same cost or it can, alternatively, be dealt with by hand truck. Heavy vices, screwing tackle, tube benders, paints and large selections of tools are eliminated from the load, and a willing wireman can carry three or four hundred feet of conduit on his bicycle, with all necessary tools in his pockets. However necessary heavy material and tools, with strong-arm operatives, may be for hot and cold water services, it is thought that they are anachronisms for a flexible agency like electricity.

With the plastic wiring systems accessories are reduced to the absolute minimum, and those that are necessary will accept several sizes of conduit, whilst such things as reducers or connectors are not used, the telescoping properties of the conduits rendering them unnecessary. All contractors know the vast amount of time that can be wasted, especially on country jobs, with men waiting for some special size of fitting, or even a single reducing bush, as it is unlikely that all possible requirements are ever foreseen when the initial supply of material is shipped.

The use of plastic conduit systems does not mean that the contractor must give up his favourite brands of switches or socket-outlets, as all patterns and types are acceptable. The standard socket-outlet with metal box can be used, but with considerable economy as compared with metal conduit; it is no longer necessary for the operative to spend an hour—costing 10s to 12s—carefully fitting the rigid conduit into the box, with locknut and brass bush, as the plastic conduit will itself make a damp-proof simple push-fit joint with the box wall, and by extending it a little way into the box it forms its own insulating bush. When conduit enters the bottom of the box it is usual to leave it butting up against the top wall of the box, as this prevents the entry of brick or other debris into the conduit which can be a considerable nuisance when the time comes to draw in the conductors. When that time arrives, the conduit inside the box is cut flush with the interior wall, affording maximum space for conductors. If the box entry is a knock-out no locknuts or anything else are required; if it has a threaded entry, the conduit will self-thread into it.

Easier Drawing-in of Cables

When cable-drawing-in time comes round further economies are possible, as the glass-smooth interior wall of the conduit permits the passage of conductors with the least effort. When plastic insulated cables are used, as is standard practice with plastic conduits, the application of a little grease or oil assists drawing-in to the extent that the conductors travel almost by themselves; certainly very long runs are possible, even with several bends, in a way impossible, or not considered good practice, with metal conduits which usually need several draw-in boxes in a longish run.

It is not uncommon to find the full 50ft length of plastic conduit employed complete, and in sub-circuit runs this can be of great advantage. What has been said about the wastefulness of the 40 per cent space restriction in conduit loading applies with even greater force with plastic conduits, for not only is condensation unlikely, and thus there is no need for drainage or ventilation, but the bunched cables are easier to move than in metal conduits.

When the job is complete the contractor is assured of an installation free from the generally-accepted drawbacks of metal conduits: condensation, rusting and floor-fill corrosion, with an earth continuity conductor which at

first test and at all subsequent tests throughout the life of the installation will exhibit maximum conductivity and minimum resistance. But for the necessity to know what the substation electrode is up to the contractor could dispense entirely with loop tests, which means he need not wait for the main supply before completing his work. This last factor, with possibly a few abortive visits to the site, can absorb costly labour and the transport of heavy testing equipment.

Reinforced Insulation

As is well known, unreliable earthing, doubtful testing methods and other difficulties are to-day focusing serious attention upon reinforced or double insulation, foreshadowing the day when appliances and equipment will not need earthing for leakage protection, even if metal-cased. To be fully effective, however, it is necessary for this principle to be extended to the wiring installation also, as it will benefit us little when the proposal for double-insulated appliances becomes an accomplished fact—and that may not be so very far ahead—if we have retained all the old problems of continuity and earthing.

We can to-day make the type of installation that will fit the double-insulated appliances, with equipment *and* wiring, one designed whole with reinforced insulation, thus bringing nearer the happy day when we can throw overboard all our earthing problems, reduce the number of pages in our wiring regulations by at least half, and to a great extent eliminate the incidence of mental strain amongst electrical installation contractors by actually preventing leakages instead of trying to overtake and isolate them after they have occurred—mostly unsuccessfully. The occupation of the writer on installation problems will disappear, but the present writer feels that the suggested modifications in wiring practice justify his claim that not only will considerable economy be achieved thereby but also an increase in technical excellence and efficiency.

There have, of course, been a few failures with the use of plastic conduits, but in all the cases investigated by the writer these have been caused by the use of unsuitable material. It is rather amazing that contractors who would never dream of placing light-gauge steel conduit under concrete or floor-fill (or try to thread it) think nothing of using the flimsiest of plastic conduits for this purpose, and wonder why flattening occurs. Grades of plastic conduits, with varying wall thicknesses, for home or tropical applications are readily available, and it is not difficult to select the proper type for the job in hand, but, enthusiast as he is, the writer cannot recommend the use of $\frac{1}{16}$in wall conduit as suitable for placing under concrete or where barrows may be wheeled over it.

One final point for serious consideration. We have got into the habit of relating installation condition and safety with age—the older the job the greater the need for periodical testing, with eventual renewal. Modern plastic materials of the types used for cable insulation and conduits have unlimited lives, or at least no known determination. Thus with the use of plastic insulated conductors and plastic conduits, both of good quality, we can forget the life aspect, and provide guaranteed installations that will outlast the buildings they inhabit, even under conditions of moisture, humidity or corrosion that would have been fatal within a few years to our older systems. There is, of course, always the risk that with the passage of centuries the copper conductors may disintegrate, and for this reason, and also the possible necessity for occasional alterations, it is essential that installations remain of the draw-in type, a method that by long usage has ingrained itself into our idea of the proper shape of things in electrical installations.

Church Installations

The Fire Protection Association, in conjunction with the Central Council for the Care of Churches, has issued a twenty-page booklet on ecclesiastical installations. " After twenty-five years," says the booklet, " the installation should be suspect." Surely conditions in churches must be the least onerous of any description of installation, and if the wiring cannot be relied upon to last more than twenty-five years it is time we tried new systems. The booklet goes on to recommend the use of m.i.c.c. or screwed conduit systems for churches, and so presumably the age of suspicion applies to these also.

Electronics in the Textile Industry

AT an informal talk before the Radio and Telecommunication Section of the Institution of Electrical Engineers in London last week, Mr. K. J. Butler discussed the applications of electronics in the textile industry. He said that the textile business was still a basic industry in this country and in Manchester approximately 16 per cent of the total working population was engaged in textile pursuits.

Electronic techniques played an important part in the efficient production of modern textiles. Conventional applications included level control of fibre in hopper, winding and reeling of yarns and fabrics, tension control during cloth-finishing processes, and edge alignment of fabrics during finishing.

The quality of textile goods was still largely controlled by constantly testing samples during manufacture. There were, as yet, few examples of electronic control devices installed as part of the manufacturing process to maintain a desired quality of product. However, electronic techniques had made a big contribution to improved textile testing equipment, and the modern quality-control laboratory used electronic instruments to measure the strength and thickness of fibres and yarns. Electronic devices had also been developed for the purpose of measuring regularity and analysing irregularities in yarn thickness and strength.

Some properties of fabrics such as " lustre," " cover " and " handle " were not so readily assessed quantitatively, but electronic techniques had sometimes enabled a more reliable quantitative assessment to be achieved.

Historic and economic considerations often prevented the application of electronic automatic control to textile processes. In some of these cases, an alternative was to use electronic equipment to monitor the correct adjustment of existing machinery, and instruments had been developed for this purpose.

Where large quantities of yarn or fabric were handled by one machine automation could be justified. One example of this was in the finishing of cloth where an electro-optical transducer was incorporated into a system controlling the correct alignment of the weft threads with respect to the warp threads in fabric.

BUSBAR PROTECTION

Application of the High Impedance Relay for Phase and Earth Fault Protection

By J. RUSHTON, Assoc.M.C.T., A.M.I.E.E.*

FOR important installations the application of busbar protection nowadays is largely a matter of course and the main decision to be made is the degree of protection to be provided. Formerly earth fault protection only was considered adequate, possibly because of the complexity of phase fault busbar protection schemes. It is now becoming standard practice to protect against phase faults especially where atmospheric conditions are difficult (e.g. pollution, salt spray, etc.).

Modern busbar protection schemes have resolved themselves into two methods (Ref. 1), the first using a high impedance unbiased relay (e.g. Metrovick FV2, Reyrolle B.3, English Electric CAG.14) as illustrated in Fig. 1, the second using a sensitive biased relay with a rectifier phase-splitting circuit as Fig. 2 (Reyrolle Mono Bias, G.E.C. Load Bias, Metrovick DK.2). The former scheme has the advantage of extreme simplicity and is now invariably used for earth fault protection. Hitherto, however, the high impedance relay has not been widely applied for phase fault protection because of the unacceptable auxiliary circuit complexity of the methods so far considered when applied to double-busbar stations. Thus the sensitive biased relays with summation c.t.s and rectifier circuits have been preferred to give phase fault protection. In spite of the relay circuit complexity, the use of the summation c.t. results in relatively simple auxiliary circuitry. These considerations are described more fully below.

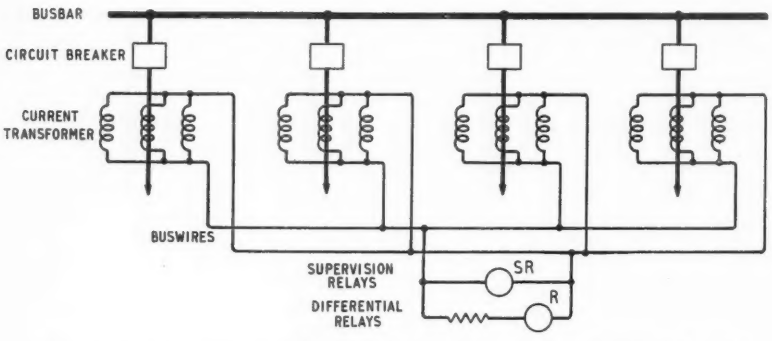
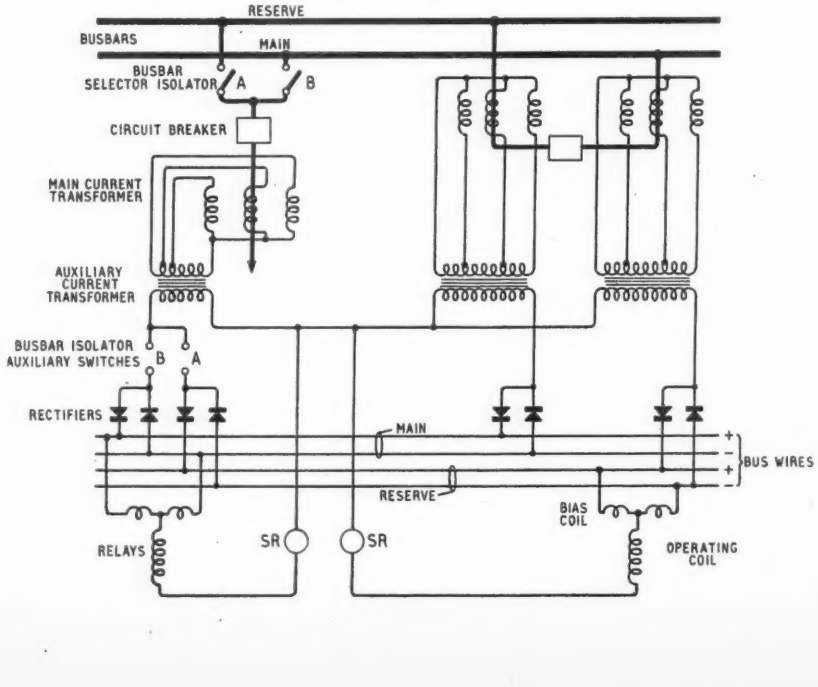


Fig. 1.—Busbar differential protection using unbiased relay (earth fault protection of single-bus installation)

Fig. 2.—Phase and earth fault busbar protection for double-bus installation using a biased differential relay and rectifiers (one typical circuit and bus coupler)



The purpose of the article is to describe a simplified phase fault protection scheme using a high impedance relay and to give design and performance details of its practical application to a 21-circuit double-busbar substation.

The obvious and basically simple method of providing phase and earth fault protection is to use a three-element high impedance relay as shown in Fig. 3. This method is extremely simple and has the advantage that all settings for all types of fault are identical. The settings are lower than for a corresponding earth fault protection scheme with residually connected c.t.s because only one c.t. per circuit is connected in parallel with the differential relay. The method is ideal for single-bus layouts or for use as a check feature with protection for a double-bus station. It has a practical disadvantage, however, when applied as the discriminating feature to a double-bus station, where the c.t.'s leads from all three phases have to be switched from main to reserve busbars in sympathy

* Mr. Rushton is with the Central Electricity Authority, South Wales Division, Cardiff.

[1] "High speed balanced current protective systems using biased and unbiased relays," by J. Rushton. *Electrical Journal*, November, 1953.

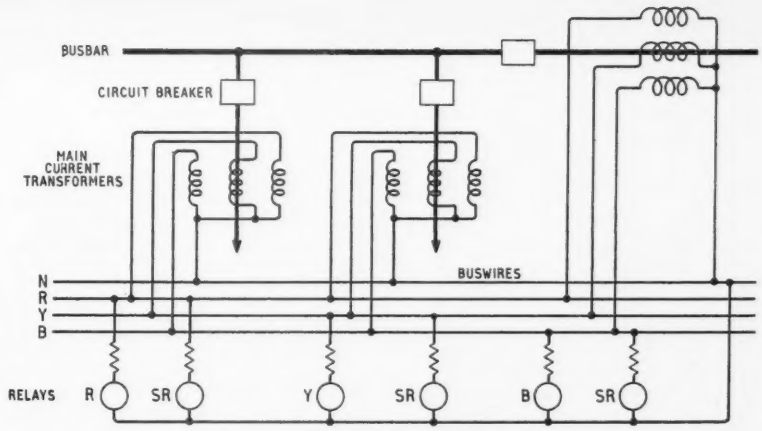
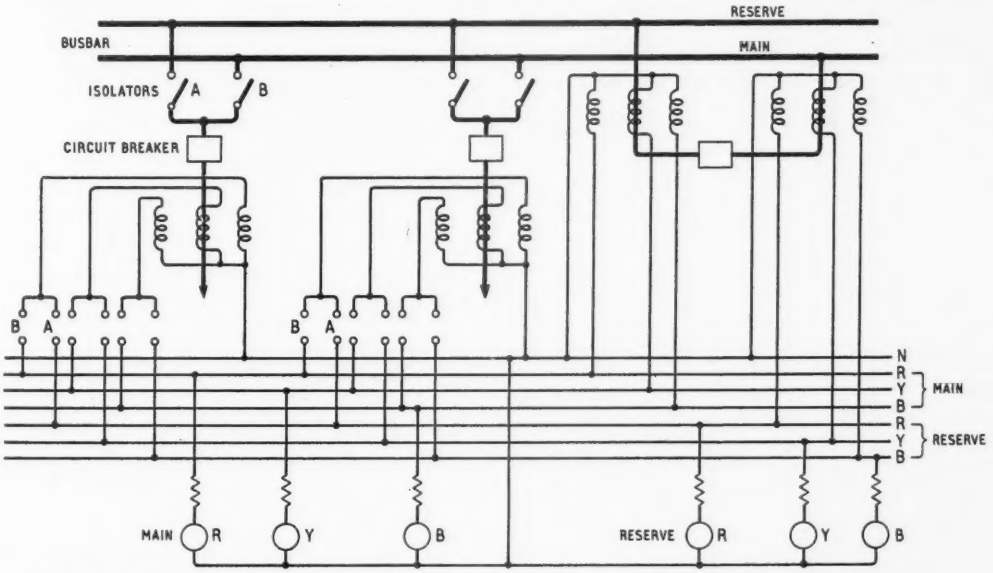


Fig. 3.—Phase and earth fault busbar differential protection using three-element relay (single-bus installation without auxiliary switching)

Below: Fig. 4.—Phase and earth fault busbar differential protection using a three-element relay (double-bus installation with bus-coupler and two typical circuits)



with the main busbar selectors (Fig. 4). These auxiliary switches are one of the weakest links in protective gear circuitry, apart from the cost of the additional switches and multi-core wiring.

As mentioned previously, single busbar layouts do not require auxiliary switches and it is bad practice to switch a check feature. The three-element scheme is highly satisfactory for either of these applications.

Summation Connection of the Main C.T.s

The problem, therefore, is to provide phase and earth fault protection using two relay buswires and a single-element relay. This can be achieved quite simply by using a summation c.t. arrangement to give an output for all conditions of energisation. The obvious method of achieving this by using an auxiliary summation c.t. in a similar manner to Fig. 2 has the great disadvantage that its own burden (of which leakage reactance may be appreciable) will adversely affect the overall performance of the scheme. In fact the size of the summation c.t. required to give effective results may approach that of the main c.t.s themselves. This method tends to be bulky and expensive, apart from any limitations in technical performance.

The addition of an auxiliary c.t. becomes unnecessary if the main c.t.s are connected to give a single-phase output for all fault conditions. This is achieved by the connection shown in Fig. 5 which is used for solidly earthed systems. The diagram shows the c.t. ratios which are all similarly wound 500/250/1 A for an outdoor substation to facilitate future changes in system phasing. Fig. 6 also indicates the c.t. secondary output for various fault conditions with 500 A flowing in the primary. It should be noted that the current transformers are wound 250 turns per layer to ensure symmetrical magnetisation of the c.t. core.

The use of the main c.t.s to provide the summation output gives the minimum possible burden and permits the use of simple theory to determine the overall performance of the scheme.

When applied to a resistance earthed system the c.t. connection must be changed to obtain earth fault settings lower than those for phase faults (Fig. 6) or, more particularly, to ensure that the phase fault through stability condition shall not prejudice the choice of relay voltage setting to such an extent that the earth fault settings are inadequate.

A typical scheme of protection showing these principles applied for the protection of a double-bus station is shown in Fig. 7. Supervision relays are shown connected in parallel with the protective relays having a setting of about one-tenth of the protection setting volage. These relays,

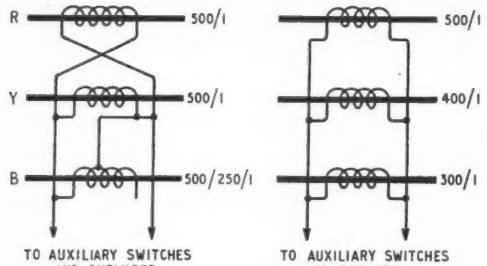


Fig. 5 Fig. 6

Fig. 5.—Summation c.t. connection of main c.t.s to give single-phase output for all types of fault (solidly earthed system)

Secondary outputs for 500 A input are :—
RN = YN = YB = 1·0 A
BN = RY = 2·0 A
RB = 3·0 A
3 Phase = $\sqrt{7}$ = 2·65 A

Fig. 6.—Summation c.t. connection of main c.t.s to give single-phase output for all types of fault (resistance earthed system)

Secondary outputs for 500 A input are :—
RN = 1·0 A YN = 1·25 A
BN = 1·66 A RY = 0·25 A
YB = 0·41 A BR = 0·66 A
3 Phase = 0·84 A

by virtue of the current circulating continuously round the circuit, serve to monitor the whole of the wiring and to give a time delayed alarm if a fault occurs.

Typical Scheme

The following notes describe the application of the foregoing principle to a 21-circuit double-bus installation comprising two discriminating zones using the summation c.t. connection of Fig. 7 and a phase-by-phase check feature as in Fig. 3.

The protection was required to be stable for through-faults up to the circuit-breaker rupturing capacity (3,500 MVA at 132 kV) and to operate satisfactorily for a minimum fault current of 1,000 A with all circuits connected.

With a c.t. ratio of 500 : 1 (characteristic as Fig. 8) the maximum secondary current under through-fault conditions is $\frac{15{,}000}{500} \times 3 = 90$ A for an RB fault. The lead burden does not exceed 0·6 ohm, the c.t. secondary resistance is 0·6 ohm for full winding and 0·3 ohm for the centre tap. For the RB through-fault condition the half-tap c.t. will probably saturate first so that the fault loop impedance is 0·3+0·6=0·9 ohm. The relay voltage setting should therefore be 0·9×90=81 V for the discriminating feature.

For the check feature the maximum c.t. secondary current is 30 A, giving a stability voltage of 30 (0·6+0·6) =36 V. The same voltage setting, viz. 80 V, was adopted for both lines of defence.

The calculated effective protection settings were 500 A for ten circuits for the least sensitive phase of the discriminating zone. Full-scale tests on a heavy current test plant revealed that these figures were safe. The tests used five three-phase sets of c.t.s., balancing one set against four for the through-fault condition on both discriminating and check zones and with five sets of c.t.s in parallel for the setting tests. The differential relay was of the hinged armature pattern with a series-tuned 50 c/s filter, a current setting of 33 MA and a voltage setting adjusted to 80 V by means of a stabilising resistor. The resistance of the supervision relay was 500 Ω. A non-linear resistor was connected in parallel with the relay to prevent dangerous voltages from appearing across the relay under high current internal fault conditions.

Through-fault stability was proved up to the maximum current of 15,300 A for all types of fault for the discriminating feature and the relay voltage setting was reduced to determine

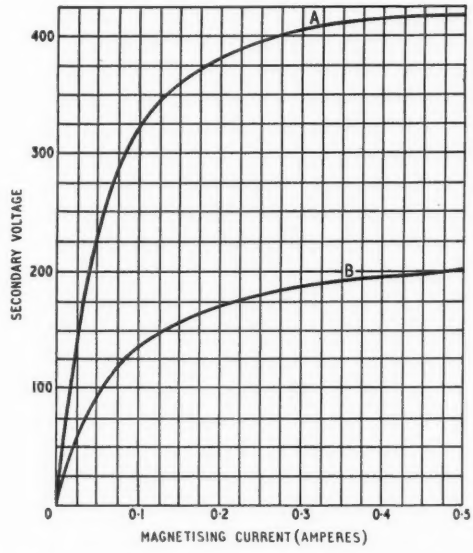


Fig. 8.—Magnetising characteristic of busbar protection current transformers

A. Full winding 500 turns. Secondary winding resistance = 0·6 ohm
B. Half winding 250 turns. Secondary winding resistance = 0·3 ohm

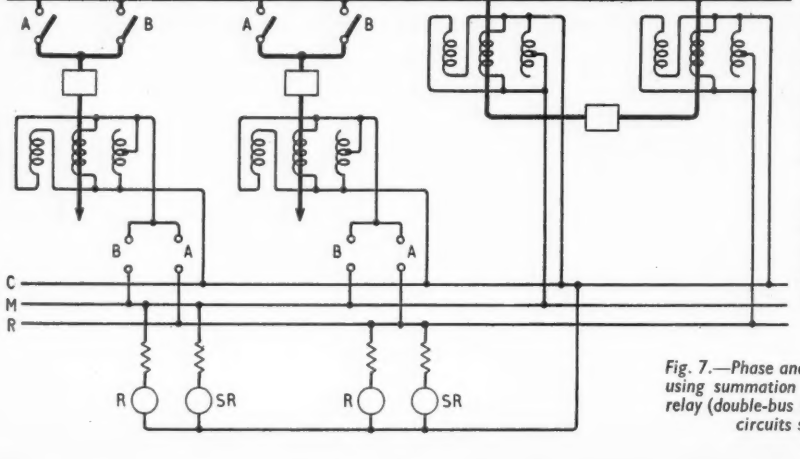


Fig. 7.—Phase and earth fault busbar differential protection using summation connection of main c.t.s and single-element relay (double-bus installation with bus coupler and two typical circuits shown, compare with Figs. 2 and 4)

the safety factor. It was found that the relay showed tendencies to instability with a voltage setting of 40, indicating a safety factor of 2. The check feature was not tested in this fashion as, by comparison, a safety factor of about 4 was to be expected. The effective settings of the protection were checked with five sets of c.t.s connected and found to be:—

Discriminating zone:	
Least sensitive setting (R-N)	270 A
Most sensitive setting (R-B)	96 A
Check zone	82 A

For internal fault conditions the relay operating time was 2¼ cycles at twice minimum setting and 1¼ cycles at 15,000 A.

The test results indicate that there appear to be no special considerations in the design and application of this scheme and that the estimated performance using standard theory contains adequate safety factors. The current transformer performance is not excessive and, in fact, could well be increased to permit greater lead burdens without embarrassing the c.t. designer.

Commissioning tests comprised the usual primary injection of each circuit against a chosen master circuit and the verification of all auxiliary switches in the c.t. and tripping circuits. The final load test was carried out by short-circuiting each c.t. group in turn and disconnecting from the buswires. The spill current across the differential relay contributed by all infeeding circuits was then noted to be in the correct ratio to the actual circuit current measured in the overcurrent relay. It should be noted that the current must be measured across the relay and not in series as the high relay impedance might otherwise constrain the circuit to indicate balanced conditions.

The scheme described provides phase and earth fault busbar protection in a simpler manner than the usual methods and is worthy of consideration for wider application. Standard relay elements are used and the current transformers are also standard except for the addition of a tapping.

It is felt that the inherent complexity of busbar protection should be minimised as far as possible and that this method goes some way towards simplifying phase and earth fault busbar protection.

Acknowledgments

The author is indebted to the Chief Engineer and the Divisional Controller (South Wales Division) of the Central Electricity Authority for permission to publish the article and also to the English Electric Co. for their assistance in carrying out the tests described.

Russian Underground Gasification

REPORT OF TEAM OF BRITISH ENGINEERS

BY invitation of the Soviet authorities, a number of British engineers visited the Soviet Union between 17th November and 3rd December to study Russian methods of underground coal gasification. The party consisted of Mr. J. Norval (chairman, National Coal Board Underground Gasification Executive), Mr. W. Noble (deputy production director, East Midlands Division, N.C.B.), Dr. A. E. Balfour (Humphreys & Glasgow, Ltd.), Mr. J. H. Lander (Sir Alexander Gibb & Partners) and Mr. F. E. Warner (Cremer & Warner).

The party arrived in Moscow on 18th November and was welcomed by Mr. Siderenko on behalf of Glavgas, the organisation controlling the gas industry of the U.S.S.R.; before the recent changes, underground gasification was the responsibility of the coal industry. On 20th November, the party left Moscow for Tula which is in the Moscow brown-coal fields. The station here has been operating since 1940 and is an old-established works which supplies gas for heating on a commercial basis to a number of manufacturing plants in Tula. The capacity is 42 million cu ft of gas per day, of about one-sixth the calorific value of coal gas. The station also operates a sulphur recovery plant in connection with gas cleaning and manufactures sodium thiosulphate. The works pioneered the development of brown-coal gasification and is still used for the experimental work on which has been based the design of larger stations for power generation.

One of these, the Schatzk station near Tula, was visited to inspect construction. This is at an advanced stage with the first coal sites beginning gasification. The first section of the power station, consisting of a two-stage gas turbine, is nearly complete. This specially designed machine produces 12 MW of electrical output. An identical unit is being manufactured in Leningrad to double the station capacity and plans have been made to add at a later stage a single 24 MW unit.

The other installation on brown coal due for completion early in 1958 is in Central Asia on the River Angren, near Tashkent, and could not be visited on this tour. The Angrensk station is planned to supply gas for burning under the boilers of a conventional power station having 100 MW initial capacity with plans for doubling.

The visits to the Tula and Schatzk stations were supplemented by a number of lectures on the way in which the gas channel through the coal can be established by operating from boreholes drilled from the surface. This was done most ingeniously with a combination of air-drying of the wet coal and the working back of a fire zone towards the air blast. In another technique, electrodes were passed down boreholes and used to make a connecting channel by applying a heavy electrical current. The equipment available for experimental and development work was on a considerable scale.

The next stage of the tour took the party to the new town of Stalino in the Ukraine where there is a design institute with 200 engineers working on plans for underground gasification plants. Some of these technologists had been associated with the pioneer hard-coal plant at Gorlovka nearby, which conducted a number of trials until it was destroyed during the war.

Apart from the brown-coal stations already mentioned as under construction, the Stalino Institute is designing hard-coal stations for construction in the Kuzbas, in Siberia. The first now operating experimentally at Yuzhno-Abinsk produces 16 million cu ft of gas per day and preparatory work is going on for two large power

stations. One at Stalinsk is planned for 400 MW and the other at Kholmogory for 1,200 MW installed capacity. At both these sites there are considerable reserves of coal with up to 17 separate seams containing more than a hundred million tons.

From Stalino the party went about 120 miles to Lisichansk, on the banks of the North Donets River. This has a gasification plant on hard coal in a traditional mining area where coal has been worked by conventional methods for over 200 years. Some 20 million cu ft of gas per day is produced here with the use of oxygen-enriched air. The use of oxygen for producing power gas is not essential and only continues because the large oxygen plant installed at Lisichansk has a regular sale for the inert gases, argon, krypton and xenon, produced as a by-product. The station is used for large-scale experimental work particularly in producing combustion channels electrically, in de-watering seams by pumping and in directed drilling.

The last technique is regarded as one which will eventually be adopted for exploiting hard coal deposits. A sloping hole is drilled from the surface and intersections with the various strata are plotted. At a predetermined point the drill is directed along a curved path in order to enter the coal almost at a tangent and the drill is then steered along the coal seam. The direction of the hole in the coal is checked by withdrawing cores and looking at the way the planes of cleavage lie in the hole. This gives an idea of the direction of the drill in relation to the way the coal is lying.

Equipment for drilling vertically from the surface and turning at right angles into a horizontal coal seam is being manufactured, though not yet on a commercial scale. The vertical hole from the surface to the coal seam is drilled by conventional methods and cased, and a small chamber is formed at the base. A small piece of casing like a 90 deg elbow joint, but hinged at the elbow so that it can be opened to a straight line position, is lowered in the open position and by means of an external projecting arm the lower part of the horizontal casing is pushed into the 90 deg position facing along the coal seam. A flexible drill string, described by the Russian lecturer as being on the same principle as a dental drill, is introduced through the casing for subsequent drilling in the coal seam.

One further plant is planned at Karminskaya to operate on thin seams of semi-anthracite up to 3ft thick and is due to be completed at the end of 1958. This will be mainly an experimental plant, but will produce gas for industrial use.

The tour was completed with a series of lectures and discussions in Moscow at the Central Institute for Underground Gasification and at the Institute of Combustible Fuels of the Academy of Sciences. At the Academy of Sciences, fundamental work is carried on into the kinetics of gas production in the various zones, in close liaison with the scientific work on gasification processes in general.

Diesel-Electric Locomotives

Main-Line Experience in the United States

IN a paper presented before the Institution of Locomotive Engineers on 18th December, Mr. G. H. McClean, M.I.E.E., M.I.Mech.E. (General Motors Corporation, U.S.A.), stated that during the past twenty years the hundred Class 1 railways in the United States (representing 99 per cent of all systems there) had increased the proportion of main-line traffic operated by diesel-electric locomotives from less than 10 to over 90 per cent. Freight now provides 84 per cent of the revenue and is 50 per cent more in volume than in 1935, but the increase is handled with substantially the same train mileage, but by longer trains. In 1935 there were 42,000 steam and 150 diesel locomotives; since then the numbers have been changed to 6,000 steam and 24,700 diesels, the latter in 1955 taking 90 per cent of all traffic.

Diesel passenger trains to-day consist of ten coaches of 700 trailing tons and their average speed is 41·7 m.p.h. with a maximum of 80 to 90 m.p.h. They are normally hauled by two-unit locomotives, each of 2,000 to 2,400 h.p. with six axles and four motors. Freight trains average 66 300-ton trucks (1,400 tons contents) at 18·6 m.p.h., including stops, 50 m.p.h. on the level and 10 to 12 m.p.h. on ruling gradients of 2 per cent. A typical freight locomotive comprises three units, two having a driving cab at one end, the other unit being without cab. Each unit is of 1,500 to 1,750 h.p. with four axles and four motors.

The engine forms 12 to 15 per cent and the electric equipment 17 to 21 per cent of the total locomotive weight. Traction motors are responsible for 40 per cent of the weight, 17 tons, of a two-axle bogie. Locomotives must operate at ambient temperatures varying from 120 deg F to minus 30 deg F, possibly within four hours, and at altitudes up to 9,000ft above sea level, frequently at full load on heavy gradients. The most commonly used engine, the two-cycle 16-cylinder V type, gives 120 h.p. per cylinder with a m.e.p. of 102 lb/sq in. On a 2,000 mile run in 40 hours refuelling at four intermediate stations may entail running on wide variations in fuel. Electric transmission from input to generator to output of traction motors at the wheel generally has a full-load efficiency of at least 82 per cent (often reaching a peak efficiency of 84·5 per cent), between 20 and 100 per cent of the locomotive maximum speed.

For load control, the driver selects any one of eight notches between idling and full load; the generator voltage and current are then automatically adjusted to secure maximum efficiency over the widest range of speed without permitting overloading or stalling of the engine. Generators and motors are forced-ventilated by filtered air. Compressed air is used for braking and steam for coach heating. Dynamic electric braking has been installed on 40 per cent of the total fleet of diesel-electric locomotives.

Prices for bituminous coal for railways in 1955 averaged nationally 480d/ton, varying by ±15 per cent for individual lines, and for diesel oil 9·7d/gal. Average coal consumption of steam locomotives amounted to 200 lb/mile and fuel-oil consumption to 1·63 gal/mile in freight service for each 1,500 h.p. unit and 1·46 gal in passenger service for each 2,000 h.p. unit. Passenger units run nearly 200,000 miles a year and freight units half that distance. Diesel freight units normally receive a major overhaul every seven years. Availability of over 85 per cent is usual. Labour content for running maintenance and heavy repairs should not exceed 40 man-hours per 1,000 locomotive-unit miles and the material used should not exceed, annually, 2 per cent of the first cost of the locomotive.

VIEWS on the NEWS

By REFLECTOR

WE are inclined to imagine that all country dwellers are clamouring for electricity, but there are exceptions. One of them, an old gentleman in Cornwall, who was interviewed by the B.B.C. Television Service recently, seems to be resisting all the blandishments of the South Western Electricity Board—although the Board "blandishes" very well. This gentleman considered that things were much more "comfortable" in his youth when electricity was a rarity. He declared that he would not have electricity if it were offered to him for nothing—nor would his wife, although we did not hear the lady's views at first hand. It isn't that he particularly dislikes electricity, which he said was "all right for some," he wouldn't have piped water either; he preferred his well which had no chlorine in it.

* * *

A couple of months ago I quoted an example of the frequent use of mW (milliwatts) instead of MW (megawatts). An article had referred to 100 mW sets for Kariba (Rhodesia), whereupon a wag wired suggesting that the order should be cancelled and torch batteries supplied instead. Remembering this, Mr. G. W. Taylor, B.Sc. (Eng.), A.M.I.E.E., of York, has sent me an advertisement of mercury primary cells from the *Instrument Review*, with illustrations one of which plainly bears the rating "14000 MAH." Mr. Taylor suggests that this is the sort of battery which was in the mind of the man who sent the wire.

* * *

The *Edinburgh Evening News* asks "Who invented the first electric locomotive?" and goes on to say that in a recent address Professor E. Oppenshaw Taylor, of the Heriot-Watt College, attributed the invention to Robert Davidson of Aberdeen who, in 1837, built a small electric motor which drove a little truck across his workshop floor. Then, with a monetary grant he built a five-ton battery locomotive which was said to have achieved a speed of 5 m.p.h. on the Edinburgh-Glasgow Railway. While this was being transported back to Aberdeen it was left in a shed overnight when it disappeared never to be seen again. Professor Taylor also mentioned a later electric train, designed by J. M. Munro, which worked back and forth on a 1¼-mile track in Scotland. Before all this, however, as I recorded in my notes of 5th July last, Thomas Davenport, a Vermont (U.S.A.) blacksmith, invented in 1834 an electric railway system, a model of which he demonstrated to Michael Faraday. Faraday liked it but "would not recommend it for investment."

* * *

I should not have thought that crop drying would present any difficulties in a country such as Trinidad, but I learn from the report of the Island's Electricity Commission that this is not the case. Mr. K. W. Finch, the general manager—who was formerly the South Western Board's district manager at Cheltenham—says that despite the tropical sun the process is a slow and expensive one. There is thus a useful opportunity for the application of electrical drying. The crops are, of course, not the usual one for which dryers are designed, as will be seen from the following extract from Mr. Finch's report:—

> "Sir Harold Robinson, at his Non Pareil Estate, carried out various tests on the drying of cacao and coffee using the normal type of electric heaters with infra-red lamps to quicken the drying of the interior of the beans. The polishing of the cacao was accomplished simultaneously with the drying by means of electrically propelled ploughs. The Commission kept in contact with Sir Harold during the various tests and in December a second all-electric dryer was installed at La Reunion by the Commission and the Cocoa Propagating Station in order to carry out further tests. Electric dryers were also installed at the Nariva-Cocal factory where difficulty was being experienced with the rubberised fibre mattresses which remained sticky and were being damaged when placed in the ovens. With the introduction of infra-red lamps the mattresses were partially dried and the difficulty successfully overcome."

* * *

One of my readers draws my attention to a report in the December *Fire Protection Review* of some unusual phenomena in Scotland:—

> "Housewives turning on the cold-water taps when their next-door neighbours are using the electric iron are alerting the fire brigade at Turriff, Aberdeenshire. The town council was told this was due to the difficulty of getting a suitable earth for the electricity supply on the rock site on which the houses are built. The ironers don't get any shock, because the irons are insulated, but the current runs through to the water pipes and the fire bell rings. Electric kettles in the area are also calling out the brigade."

* * *

As far back as 1887 it was recognised that lack of standardisation of fittings was a handicap to the infant electricity supply industry. G. L. Addenbrooke, writing in the *Electrical Review* of 30th December in that year, compared electricity unfavourably with gas in this respect. He was perhaps a little ahead of his time for electrical fittings were in a more or less rudimentary stage. Yet he said:—

> "Some firms even go to the length of purposely making the things they manufacture of different sizes from those of other people, in order that other people's work may not fit theirs, and so, as they think, customers will always be obliged to come to them for everything. But this is a short-sighted policy in the long run."

Now, seventy years later, there is still too much variety among the commonest "bread-and-butter" accessories in spite of the good work of the British Standards Institution over many years.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

We learn from *Contact*, the magazine of the Merseyside and North Wales Electricity Board, that **Mr. Norman T. Smith,** M.I.E.E., is retiring at the end of the year from the post of general manager of the Nova Scotia Electric Light & Power Co., which he has held since 1949. Mr. Smith is a former Kirkcudbrightshire County electrical engineer and borough electrical engineer of South Shields and Warrington. Before going to Nova Scotia he was a sub-area manager with the Merseyside and North Wales Board.

Marconi Instruments, Ltd., has formed a new engineering group. The main duties of this section will be general research investigations; research in connection with nucleonics; technical liaison with other research organisations; and the applications of semiconductors to the company's products. **Mr. G. M. Ettinger,** M.Sc., has been appointed engineer-in-charge of this new group. He previously held a senior post at the Whetstone Laboratories of the English Electric Co., Ltd. After obtaining his electrical engineering degree at London University, Mr. Ettinger was awarded a Fulbright Fellowship for post-graduate work at New York University and Columbia University, New York. He spent some time with the Research Division of New York University, developing special instruments for oceanographic measurements, and subsequently joined R.C.A.'s patent research and planning division. Later, he was appointed chief project engineer of the Standard Electronic Research Corporation, New York, specialising in X-ray and nucleonic equipment. Before joining the English Electric Co. in 1955, he was in charge of advanced development of Air Trainers, Ltd., where he was connected with the development of the flight simulator for the "Elizabethan" air-liner. Mr. Ettinger is the author of a textbook on magnetic amplifiers, and has contributed a number of articles to technical journals, including the *Electrical Review*.

Mr. G. M. Ettinger

Mr. G. S. C. Lucas, a vice-president of the **Institution of Electrical Engineers,** told members and their guests at the annual dinner-dance of the Southern Centre, held at the Polygon Hotel, Southampton, on 12th December, that collaboration between university colleges, technical colleges and the industry in which electrical engineers were actively engaged was regarded as highly important by the Council of the Institution. Mr. Lucas was responding to the toast to the Institution, proposed by Professor W. I. Lucas, deputy vice-chancellor of Southampton University. He said that the promotion of better relationships between industry and the academic faculties was one of the objects of officers and committee members of the Institution. It was apparent that this collaboration was essential to the future expansion of the profession. There was so much knowledge in the world to-day that unless we could present it concisely and precisely to the student we were in danger of turning out narrow specialists instead of engineers with a broad basic knowledge of fundamental science and an appreciation of the humanities. There was a need for teachers as well as researchers in the universities and colleges. The sandwich course was recognised as a good combination of university education and works experience. The Southern Centre was an important one inasmuch as it had a membership of 1,833.

Professor Lucas, in proposing the toast to the Institution, paid tribute to the achievements of electrical engineers over the years.

Mr. L. P. Float, station superintendent, Watford generating station, is retiring from the service of the Eastern Region of the Central Electricity Generating Board on 28th January after having completed forty-eight years' service in the industry. Mr. Float commenced his career as a premium pupil with Morley Corporation in 1909. He was appointed deputy station superintendent at Watford in 1948 and station superintendent in 1953.

Mr. K. C. Hibbert, A.M.Inst.F., deputy station superintendent at Watford, has been promoted station superintendent as from 1st February. He commenced as an apprentice at Battersea generating station in 1934, was appointed combustion engineer with the Northmet Power Co. at Brimsdown power station in 1943 and was subsequently assistant shift charge engineer and then shift charge engineer until his appointment at Watford as deputy station superintendent in 1955.

Mr. L. P. Float

Mr. K. C. Hibbert

Higgs Motors, Ltd., has appointed **Mr. T. Humble,** A.M.I.E.E., A.M.I. Prod.E., as works manager. Mr. Humble, who for the past three years has been production manager of Crompton Parkinson (Doncaster), Ltd., f.h.p. motor factory, received his initial engineering training as an apprentice of A. Reyrolle & Co., Ltd., Hebburn-upon-Tyne. He spent four years with the Hotpoint Electric Appliance Co., Ltd., at its Peterborough factory, and before that was with the Brush Electrical Engineering Co., Ltd., Loughborough (rotating electrical machine division), for ten years. He took up his present appointment on 1st December.

The Board of Trade announces the appointment of **Mr. K. McGregor,** C.M.G., an Under Secretary in the Industries and Manufactures Department, as the United Kingdom Senior Trade Commissioner and Economic Adviser to the High Commissioner in Canada in succession to **Mr. G. Bowen,** C.M.G., who will return to the headquarters of the Board on completion of his tour of duty. Mr. McGregor, who was responsible for co-ordinating the arrangements for the Canadian Trade Mission to the United Kingdom and accompanied them during their visit, will take up duty in Ottawa next summer. He was formerly in charge of the North American Division of the Commercial Relations and Exports Department of the Board.

Some changes will take place in the north west area representation of the Ransome & Marles Bearing Co., Ltd., from 1st January. The area manager, **Mr. A. P. Gibbs,** will be taking up an appointment at head office. **Mr. H. V. Willder** will then become manager of the Manchester office assisted by **Mr. E. L. Paton.** The Liverpool sub-office manager will be **Mr. G. H. Walker,** the present stores supervisor.

The London Electric Wire Co. & Smiths, Ltd., and its associated companies, Frederick Smith & Co., the Liverpool Electric Cable Co., Ltd., and the Vactite Wire Co., Ltd., have appointed **Mr. G. T. Richards,** A.M.I.E.E., manager of the Liverpool

Mr. G. T. Richards

Mr. W. A. Sloane

branch with effect from 1st January on the retirement of **Mr. W. A. Sloane.** The services of Mr. Sloane will be retained in a consultative capacity.

"Electricity, besides being a most convenient form of light, heat and power, is now, with increases in the cost of coal, gas and oil, also the most economical. With the advent of nuclear power stations and cheaper electricity, the time will soon be approaching when electricity will be the only form of heating installed in new premises." This forecast was made by Mr. J. V. Hutchings, chairman of the Northampton Branch of the **Electrical Contractors' Association,** at the Branch's annual dinner and dance at Overstone Country Club last week. The national president of the E.C.A., Mr. H. S. Wathes, said he had recently had an opportunity to meet the Minister of Works and tell him that electrical contractors intended to provide a full intake of craftsmen and technicians in industry, and that theirs had always been a training ground for all sections of industry—a fact that the Minister's Department had always been slow to accept. The 200 guests applauded when told that the 3,000 electrical contractors in the country now handled 85 per cent of all electrical installations.

On 7th December the twenty-second annual meeting of the **Sangamo 15 Year Club** (Sangamo Weston, Ltd.) was held at the Coventry Street Corner House, London. It took the customary form of a dinner, dance and cabaret. Membership of the Club is open to all employees, male and female, who have completed fifteen years' service with the company. This year some 375 members attended out of the total membership of the club which now numbers 500. Two directors of the company were present at this year's dinner, Mr. H. A. Springer and Mr. F. R. Butherus.

The festive spirit was very much in evidence at the Christmas party of the **Pressed Steel Co., Ltd.,** attended by a large gathering recently at the company's Regent Street, London, showrooms. Christmas trees, holly, children (from Dr. Barnardo's Homes) and presents all went to make the party complete. Guests of honour were Johanne Bendtsen and Kaj Sivertsen, two Eskimos from North West Greenland, Mr. Peter Scott, the ornithologist, and last but not least two penguins who caused a stir in Regent Street by entering the showrooms on a red carpet. In addition to a varied selection of "cold cookery" for the guests, each received a present from Johanne and Kaj (from an igloo), and the children received presents from a Christmas tree.

Mr. J. R. Greenwood, Junr., general works manager, has been appointed a director of Craven Brothers (Manchester), Ltd., Stockport. He has been with the company since 1928 and is the nephew of Mr. J. R. Greenwood, chairman and managing director.

The annual children's Christmas party at the Willesden Works of the **British Thomson-Houston Co., Ltd.,** on 14th December was attended by 425 young guests. A skiffle group, tea, a stage show, and a Father Christmas with gifts for everyone were ingredients for an enjoyable afternoon.

The Mond Nickel Co., Ltd., announces that **Major C. Johnson,** manager of the precious metals refinery of the Mond Nickel Co., Ltd., will relinquish his appointment on 31st December, having reached retirement age. He will be succeeded by **Mr. A. R. Raper.**

Captain E. Brook Williams, manager of the Aerad Division of International Aeradio, Ltd., since its formation in 1948, is retiring at the end of the year, having reached the age of sixty. His services, however, will still be available as an independent consultant.

The article on "Steelworks Supply and Distribution" (page 1149) was written by **Mr. J. E. McCartney,** who served for three years in the Electrical Department of the Royal Navy after a general education at the Jordanhill College School and the Glasgow Academy. On demobilisation, he attended a sandwich engineering course at Glasgow University and graduated B.Sc. in electrical engineering in 1951. Periods of student training were spent with the British Thomson-Houston Co., Ltd., and the South of Scotland Electricity Board, and since 1950 he has been employed by Colvilles, Ltd., as an electrical engineer in the Group Engineering Department. During 1953 he attended a course at the Glasgow Royal Technical College and was awarded a post-graduate diploma in power engineering.

Mr. J. E. McCartney

Members of the West London branch of the **Association of Supervising Electrical Engineers** recently visited Holophane House, Westminster, to hear a talk by a member, Mr. S. E. Harris. The subject was flameproof lighting for hazardous areas and before the meeting Mr. Harris showed Mr. G. Noyes (chairman) and Mr. N. O'Hara (branch secretary) the Holophane museum of photometric apparatus.

The Minister of Power has reappointed **Sir Arthur Howard,** K.B.E., C.V.O., D.L., J.P., of Steyning, Sussex, as part-time member of the South Eastern Electricity Board.

Mr. E. K. Cole, chairman and managing director, presented gold watches to sixteen employees of **E. K. Cole, Ltd.,** who have completed twenty-five years' service with the company at a ceremony in the Ekco Clubhouse, Southend-on-Sea, on 17th December. These latest awards bring the total number of recipients to 219.

Mr. J. Rushton, Assoc.M.C.T., A.M.I.E.E., the author of "Busbar Protection" (page 1156), was educated at the Manchester College of Technology. He served his apprenticeship with the Metropolitan-Vickers Electrical Co., Ltd., and subsequently served in the Instrument and Meter Engineering Department of the company as protective gear application and development engineer. In 1953 he joined the Central Electricity Authority (South Wales Division) as divisional protective gear engineer.

Mr. J. Rushton

WILLS

Mr. Frank Christy, M.I.E.E., founder of Christy Brothers, Ltd., who died on 13th May last, left £27,905 gross (£27,751 net).

Mr. W. Phillips, A.C.G.I., M.I.E.E., late chief electrical engineer, Elliott Brothers (London), Ltd., who died on 10th October last, left £6,397 gross (£6,312 net).

Mr. J. D. Bannister, for 29 years a public lighting engineer with the General Electric Co., Ltd., Manchester, who died on 5th June last, left £7,551 gross (£7,441 net).

Mr. J. E. Ford, of Tamworth, Staffs, electrical engineer, who died on 6th June last, left £51,177 gross (£50,840 net).

Mr. G. A. Jackson, for 19 years managing director of Freemans' (Electrical Contractors), Ltd., Brierley Hill, who died on 10th April last, intestate, left £7,076 gross (£7,026 net).

Mr. H. C. R. Dagnall, formerly chairman of Bullers, Ltd., who died on 30th June last, left £41,054 gross (£37,763 net).

Mr. T. McCulloch, works manager with A. Reyrolle & Co., Ltd., who died on 30th July last, left £10,794 gross (£8,495 net).

Prof. W. Brown, B.Sc., A.M.I.E.E., F.R.S.(E.), Emeritus Professor of Mathematics, Hong Kong University, who died on 14th April last, left personal estate in England and Scotland valued at £32,065.

Mr. F. B. Thorpe, for many years head of F. B. Thorpe & Sons, Doncaster, who died on 22nd December last, left £27,308 gross (£25,262 net).

Mr. K. W. Tremellen, for many years in the Research Department of the Marconi Co., and closely associated with Marconi in many of his early experiments, who died on 3rd April last, left £3,667 gross (£3,609 net).

French Thermal Power Stations

CONSTRUCTION PROGRAMME UP TO 1965

IN a lecture delivered on 18th December at a joint meeting of the Supply Section of the Institution of Electrical Engineers and the British Section of the Société des Ingénieurs Civils de France, Mr. J. Pimpaneau gave particulars of the construction programme for thermal generating plant of Electricité de France up to 1965.

The programme provides for the installation between 1957 and 1961 of forty 115 MW (125 MW max. rating) standard generating sets, ten of which are now on order, as is also a 250 MW set for later installation. Auxiliary plant will also be standardised, for which the driving motors will be supplied at 5·5 kV for 150 h.p. and above and 380 and 220 V for smaller capacities. The main annual financial charges for a four-unit 115 MW power station having a life of 30 years will be proportioned in percentages broadly as follows: station site, buildings and equipment, 20 (of which four-fifths is due to equipment); fixed operation (administration, rates and taxes, salaries and wages), 10; running costs (mainly fuel), 60; 50 km of 225 kV line and losses in it, 5.

A site area of 100 to 200 acres may be required, allowing for storage of 400,000 tons of coal, assuming a yearly consumption of 10 million tons. About 16 million gal/hr of cooling water for condensers would be needed by a riverside station or 250,000 gal/hr by a cooling-tower station running at a 3 per cent lower efficiency. Net specific fuel consumption per kWh for recent French power stations is about 2,300 k cal (9,126 B.Th.U) at most economic loading and 2,600 k cal (10,316 B.Th.U) in everyday operation. The operation staff required is 0·4 man per MW. All new plants operate on the isolated unit system.

Research is being concentrated on increasing steam pressures and temperatures. Data compiled by Chadwick show net specific consumptions in B.Th.U/kWh as follows: at 750 deg F and 400 lb/sq in, 13,500; at 1,000 deg and 1,500 lb, 10,000 without and 9,500 with single reheat; at 1,100 deg and 2,400 lb, 9,300 with and 9,000 without reheat. Extrapolation of the curve to 1,600 deg and 8,000 lb gives 8,000 with double reheat.

Data by the American Gas and Electric Service Corporation show specific consumptions per kWh, at 1,050 deg F and 2,000, 3,500 and 4,000 lb/sq in to be 8,900, 8,680 and 8,590 B.Th.U with one stage of reheat and 8,835, 8,587 and 8,555 B.Th.U with two stages of reheat; for 1,200 deg F and the same pressures, the corresponding figures are 8,630, 8,375 and 8,300 B.Th.U; 8,500, 8,375 and 8,220 B.Th.U; and 8,500, 8,220 and 8,130 B.Th.U. These figures show that at 1,050 deg it is useless to increase the pressure above 4,000 lb/sq in, but that at 1,200 deg a progressive reduction in specific consumption takes place up to between 4,000 and 5,000 lb/sq in, particularly with two stages of reheat.

British and French Comparisons

Mr. F. H. S. Brown (C.E.A.) observed that in the past dissimilarities had in some respects been more marked than similarities in French and British practice. The paper showed that practice in France and Britain was converging and that the solutions to common problems were becoming very similar indeed. The basic problems were similar, although the systems differed in size. There were differences in siting. The author preferred to site his stations where fuel could be supplied by both rail and water, but in this country it was more difficult because the rivers were smaller. This made it difficult also to site inland stations with direct cooling in contradistinction to the author's preference for siting stations, even inland, where direct cooling was possible. In this country there would be a trial installation with a so-called dry cooling tower in connection with a set of 120 MW rating, and it would require no cooling water make-up at all. The outdoor station was of interest. In this country boilers were sometimes put out of doors, but not turbines so far.

Mr. D. B. Irving (London Electricity Board) asked whether the staffing was brought down to 0·4 man/MW with the full co-operation of the trade unions. Was that the answer? He also pointed out that in this country one had only to propose a power station or overhead line and an avalanche of objections arrived, despite the admission that electricity was necessary. Was that experienced to the same degree in France?

Site Planning

Mr. F. J. Hutchinson (Kennedy & Donkin) recommended aerial surveys as a means of planning sites, access to which was not available for legal or other reasons. Once the site was obtained, it was necessary to know the geology to determine foundation placings and excavation routes. Geophysical methods such as soil resistivity and seismic methods could be used for proving purposes. He asked about the disposal of fly ash and said that methods were being tried in Scotland to control the concentration of fly ash so as to use one-third of the h.p. that would have been used without controlled concentration. With regard to staff, he said a figure of 0·4 man/MW could probably not be obtained in this country on a 500 MW station if all the station personnel were included. The centralisation of coal-handling plant control could produce a striking reduction in manpower.

Mr. W. J. Price (Metropolitan-Vickers) said an increase in the size of sets to the now contemplated 550 MW would reduce the personnel required to operate the station. There was also an automatic data logger which would revolutionise operation and possibly reduce personnel. With regard to cooling towers, he doubted whether there had been sufficient study of temperature conditions in this country as compared with Russia. He also recommended a study of the back end of the turbine, the cold and wet end. This was particularly important in connection with nuclear power stations which were exceedingly wet to begin with. He expressed horror at the waste of heat which he compared with the burning of 27 cu ft of oil in Persian oilfields for every cu ft that went down the pipeline. He suggested using this heat in greenhouses.

Mr. A. W. Pedder (Merz & McLellan) said that while many of the author's conclusions must be accepted without serious argument, there were one or two that were open to question. For instance, in new stations with large sets it would probably be more economical to use three voltages than to standardise auxiliary voltages.

Again, the author favoured steel frames, but both in this country and abroad a number of very economical reinforced concrete turbine houses had been constructed.

Mr. R. F. Alexander (Balfour, Beatty) said that the construction costs of the order of 20 per cent for a 500 MW station were about the right proportion for this country. But the cost of a nuclear station was double that amount, in large measure due to the very massive foundations for reactors and heat exchangers, and also the complicated work in the biological shielding. The power house section could, however, be compared with its counterpart in the thermal station. He described a thermal station and a nuclear station which his firm were building and made comparisons of the costs.

The author briefly replied through Mr. G. Froud and a vote of thanks was proposed by Mr. B. A. E. Hiley, president of the British Section of the Société des Ingénieurs Civils de France.

CANADIAN TRADE MISSION

Measures to Facilitate the Expansion of British Exports

BEFORE they returned home last week at the end of what is generally agreed was a highly successful three-and-a-half-week tour of British industry, the 57 members of the Canadian Trade Mission held a one-day conference with the Dollar Exports Council. In the light of experience gained during the tour, statements were made by the Hon. Gordon Churchill (Canadian Minister of Trade and Commerce and chairman of the Mission) and by Sir William Rootes (chairman of the Dollar Exports Council) on the measures which it had been agreed should be taken in both countries to promote and facilitate British exports to Canada.

In Canada the campaign to encourage Canadians to buy more from Britain and less from the United States will be intensified and, in particular, an analysis will be made of Government and local authority purchasing so that imports from Britain shall, as far as possible, replace those from other sources. Canadian buyers will be asked to plan further ahead to give British firms a fair chance of meeting the required delivery dates. The individual members of the Mission will, in addition to publicising the favourable impression which they have gained as a result of the tour, offer help and advice to representatives of British firms seeking to establish business in Canada.

British Mission to Canada

For their part, the Dollar Exports Council are planning to send a small but strong Mission to Canada next spring which will travel across the country visiting our own trade centres, tightening up British industry's public relations and other aspects of our Canadian trade to maximum efficiency. Half-a-dozen men, who are themselves small but successful exporters to Canada, are to be asked to accept appointments as leaders of selling groups formed of smaller exporters selling different products to the same buyer. Larger exporters with sales and warehouse facilities will be invited to accept agencies for smaller exporters. British firms will also be encouraged to provide places for Canadian apprentices and students. The British Trade Commissioners in Canada will be called together next month to meet members of the Canadian mission to establish how the Trade Commissioners can best further the expected growth in the activities of British exporters.

In the meantime the Dollar Exports Council have made two specific requests to the Canadian Trade Mission. The first of these draws attention to the need for overcoming the " sheer momentum of establishing trade connections, especially with utilities, manufacturers and perhaps municipalities as buyers," and asks the Mission to use its influence to ensure that when re-ordering takes place fresh tenders are called for so that British firms may get a chance of competing. The second request concerns the testing and certification procedures for pressure vessels and gas appliances, and urges that some arrangements be made, similar to those successfully operating for electrical apparatus, whereby the procedure can be carried through in the United Kingdom.

Favourable Impressions

During their tour the Canadian Trade Mission visited about a hundred industrial establishments and more than 1,000 British manufacturers availed themselves of the facilities offered for making direct contact with the members. In their statement the Mission said they felt that, speaking broadly, British industry was showing leadership of a high order in its scientific research, in its new technologies and in the efficiency of its manufacturing practices. The members of the Mission were also favourably impressed with the knowledge, ability and leadership of the senior personnel, the skill, artisanship and productivity of the workers, and the friendly relationship existing between management and men.

Imports from Britain, which represented 18 per cent of Canada's total imports in 1939, had dropped to 11 per cent in 1949 and were only 8½ per cent in 1956. An increase in imports from Britain would help Canada to reduce her growing imbalance with the United States, which last year supplied 73 per cent of the total. The main problem in stimulating British exports rested with the medium and smaller firms who in aggregate represented a very large productive capacity.

British goods had two outstanding advantages in the Canadian market: the price was competitive compared with that of American imports and the quality was generally recognised as being first class. The disadvantages arose from the geographical position of the two countries and from the fact that Canadian tastes and standards were largely conditioned by those of the U.S.A.

More Publicity Needed

In suggesting measures that might help to strengthen the commercial relationships between Britain and Canada, it was pointed out that a decision to enter the Canadian market should not be taken lightly, but should be based on a thorough investigation by a senior executive and on a firm resolve to give the market a fair trial over three to five years. Long delivery periods were the greatest obstacle to increased imports and British firms should therefore give voluntary priority to Canadian orders.

Where a suitable agent could not be found it was often more satisfactory to train a Canadian in British factories

rather than to send out a fully trained man who was unacquainted with Canadian merchandising methods.

British exporters, particularly of consumer goods, must also be prepared to spend more on advertising than they would in the home or sterling area markets, and it was suggested that they should avail themselves of the services of local advertising agencies who knew how to appeal to the Canadian public. Thought should also be given to co-operative efforts among firms engaged in the same line of business and to a "Buy British" campaign staged by all exporters. Britain should also find ways of bringing home to the Canadian people her scientific and industrial achievements, and her leadership in nuclear development. As the report puts it: "Your genius for understatement is charming—but it certainly isn't a promotional asset."

The Times reports that at a subsequent meeting between the Dollar Exports Council and representatives of the Board of Trade, the Canadian Government and national trade organisations, it was decided that:—(1) A list of all British firms who express interest in the Canadian visit will be compiled and sent to Canada; (2) the High Commissioner for Canada in London will contact these companies in Britain and offer them the services of Canada House; (3) the Dollar Exports Council will give these companies a comprehensive list of agencies who are experts in Canadian trade and can give immediate assistance; and (4) the Council will contact companies with training facilities for apprentices and students and urge them to reserve places for Canadians. A list of these companies will be sent to Canada.

National Board Salaries

THE customary White Paper on members of the boards of nationalised industries, showing the position as at 1st November, has been published by H.M. Stationery Office (Comd. 332, price 1s). This gives for the first time the names of the members of the Electricity Council and Central Electricity Generating Board and shows the increased salaries instituted earlier this year. It also includes the personnel of the Central Electricity Board which ceases to exist on 1st January. We extract below the main details of the new Board and Council:—

CENTRAL ELECTRICITY GENERATING BOARD

Name	Salary	Date of Appointment	Appointment Expires
Chairman:			
Sir Christopher Hinton	£10,000	1st Sept., 1957	31st Aug., 1962
Deputy Chairman:			
Mr. C. R. King	£7,500	1st Sept., 1957	31st Aug., 1960
Full-time Members:			
Mr. F. H. S. Brown	£7,000	1st Sept., 1957	31st Aug., 1962
Mr. Ernest Long		1st Sept., 1957	31st Aug., 1962
Mr. A. R. Cooper		1st Oct., 1957	30th Sept., 1962
Part-time Members:			
Mr. G. A. S. Nairn	£1,000	1st Sept., 1957	31st Aug., 1959
Sir Leslie Nicholls		1st Sept., 1957	31st Aug., 1962
Sir Charles Geddes		16th Sept., 1957	15th Sept., 1960
Sir William Holford		16th Sept., 1957	15th Sept., 1958

ELECTRICITY COUNCIL

Name	Salary	Date of Appointment	Appointment Expires
Chairman:			
Sir Henry Self	£10,000	1st Sept., 1957	31st Aug., 1959
Deputy Chairmen:			
Sir Josiah Eccles (full-time)	£7,500	1st Sept., 1957	31st Aug., 1962
Professor R. S. Edwards (part-time)	£2,000	1st Sept., 1957	31st Aug., 1962
Full-time Member:			
Mr. C. T. Melling	£7,000	1st Oct., 1957	30th Sept., 1962

Other members of the Electricity Council are the chairman of the Central Electricity Generating Board, the chairmen of the twelve Area Electricity Boards, and two representatives of the C.E.G.B. (Messrs. C. R. King and Ernest Long). All these receive the salaries of their own appointments. Lord Citrine, the present chairman of the C.E.A., is to be a part-time member.

Chairmen of Area Electricity Boards receive a salary of £6,500, deputy chairmen £5,000 and part-time members £1,000 (with £500 extra for chairmen of Electricity Consultative Councils).

The White Paper also contains particulars of the two Scottish Boards. The chairman of the North of Scotland Board (Mr. Thomas Johnston) and the deputy chairman (Sir Hugh Mackenzie) are unpaid; the seven part-time members receive £1,000 (except the chairman of the Consultative Council, Sir George T. McGlashan, whose salary is £1,500 but who draws only £1,250).

Mr. J. S. Pickles, chairman of the South of Scotland Electricity Board, has a salary of £7,500 and the deputy chairman (Mr. W. Hutton) £6,000. Part-time members are paid £1,000 and the chairman of the Consultative Council (Mr. John Sullivan) £1,500; a footnote states that Mr. Sullivan is paid "a fee of £500 in addition in respect of additional duties."

It may be noted that the chairman of the Gas Council is paid a salary of £8,500 (with an allowance of £1,000) and the deputy chairman £7,500 (allowance £500). Chairmen of Area Gas Boards are paid £6,500 (allowance £500), deputy chairmen £5,000 (allowance £400), full-time members £4,000 and part-time members £1,000 (£500 more for chairmen of Consultative Councils).

Letter to the Editor

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents

Lord Kelvin and the I.E.C.

WE have read with interest the article in your issue of 30th November from a correspondent retracing the career of Lord Kelvin on the occasion of the 50th anniversary of his death.

In this connection, it may be of interest to your readers to recall that Lord Kelvin was the first president of the International Electrotechnical Commission. The interest he took in the I.E.C. is well exemplified by the following quotation from a letter written on 8th November, 1907—scarcely a month before his death—to Charles le Maistre, then secretary of the I.E.C.:—

"I am much pleased with what you tell me regarding the general progress of the I.E.C., in its work, which is surely destined to bear good fruit throughout the world."

Geneva. L. RUPPERT,
Secretary,
International Electrotechnical Commission.

PARLIAMENTARY REPORT

Defence Contracts Bill

MOVING the second reading of the Defence Contracts Bill, Sir David Eccles said that it revoked Regulation 3 of the Defence (Patents, Trade Marks, etc.) Regulations, 1941, under which the Government could authorise the use of "know-how" in any Government contract. For those emergency powers the Government proposed the substitution of more strictly defined permanent powers. They would now be limited to the right to authorise the use of inventions, designs and "know-how" for the services of the Crown only.

The Bill was read the second time.

Nuclear Fusion Research

Questioned by Mr. Mason about the "ZETA" equipment at Harwell, Mr. Butler, Lord Privy Seal, said that it was hoped to publish full scientific details of the experiments early in the New Year. Earlier, Mr. Maudling, Paymaster General, had said that a proposal had been made to the United States and United Kingdom Joint Declassification Committee that details of the "ZETA" experiments should be published.

Canadian Mission and British Railways

In the House of Lords the Minister without Portfolio (Lord Mancroft) told Lord Forbes that with the exception of the experimental Swiss gas turbine electric locomotive used between London and Cardiff, all train journeys made by the Canadian Trade Mission while in this country were made with British rolling stock. They included a journey in a special train drawn by the prototype British diesel-electric "Deltic" locomotive and another in a diesel railcar.

Electrical Publicity

Lord Lucas of Chilworth asked the Minister of Power to state the cost of the goodwill advertising now being carried on by the Central Electricity Authority in the national Press.

For the Government, Lord Mills replied that the cost of this series of advertisements which had been appearing during the past two months in selected newspapers and journals was about £50,000. There had been five in the series. Their purpose was to explain to the public the need for the nuclear power programme and associated developments, including the erection of transmission lines. "It is for the Authority to decide what forms of advertising are economically justified—subject to the general requirement that they should exercise reasonable restraint in their advertising expenditure," said the Minister. "But I would suggest that this campaign has accorded well with the suggestions made by Lord Lucas and others in the debate on 2nd April that the implications of the power programme should be explained to the public in simple language."

Electricity in Wales

In the debate on Welsh affairs, Mr. George Thomas spoke of the grave shortage of science and technological teachers in the Principality. Mr. Clewyn Hughes complained that the Government's restrictions on capital investment were having a serious effect upon rural electrification.

Replying to the debate, the Minister for Welsh Affairs, Mr. Henry Brooke, made a brief reference to the two sites in Wales selected for atomic power stations. He could not express any views on the suitability of those sites, he said, for inquiries were pending. But he could say that he did all in his power to encourage the Central Electricity Authority to direct its attentions to North Wales.

Unattended Television Transmitters

The Postmaster General (Mr. Marples) informed Mr. Hayman that the B.B.C. hoped that the prototype of a low power unattended television transmitter would be ready for field trials early in the New Year. Amongst other things these trials would show the kind of areas for which this equipment was likely to be suitable.

Radio Interference

Mr. Charles Hobson asked the Postmaster General how many regulations under the Wireless Telegraphy Act to deal with electrical interference were now in operation and what steps were taken to enforce them.

Mr. Marples said three sets of regulations were now in operation. They could be enforced in individual cases by notices served by him under Sections 11 and 12 of the Wireless Telegraphy Act, 1949.

Mr. Hobson said there had been considerable interference to v.h.f. radio sets from the emission of electromagnetic energy from motor cars and other electrical equipment, including television sets.

Mr. Marples said if he could have particulars he would have such interference investigated. The real difficulty was that the new regulations applied only to new motor cars and so on made after June, 1953.

D.S.I.R. Five-Year Plan

In reply to Mr. Frederick Willey, the Parliamentary Secretary to the Ministry of Works (Mr. Harmar Nicholls) said that the activities of the Department of Scientific and Industrial Research were developing broadly along the lines planned. At the end of 1957-58, the fourth year of the five-year plan, it was estimated that the staff would have increased by about 750 out of a planned increase of 800, though the Department, in common with all other employers, had not been able to recruit all the specialist staff it required. The provision of new buildings had also fallen behind, largely owing to restrictions on capital expenditure, but by the end of the year about half the planned building programme would have been completed. The plans of the Department for the five-year period 1959-64 were at present in course of preparation and were being considered by the Council for Scientific and Industrial Research.

Railway Modernisation Programme

Mr. Ernest Davies asked the Minister of Transport which of the British Railways modernisation schemes would be postponed or delayed as a result of the restrictions placed on its capital investment programme.

Mr. Watkinson said it would not now be possible to accelerate by as much as was hoped the programmes for main line diesel locomotives, for some rolling stock and for station improvements. The programme for the fitting of continuous brakes to some mineral wagons had also had to be slowed down. The Commission still hoped, however, that by maintaining and if necessary accelerating its plans in subsequent years, it would be able to complete the programme by the published date.

Mr. Strauss asked if it was not a fact that the cut in capital expenditure had done enormous damage to the modernisation scheme, and that it would not be possible to make up for it in subsequent years.

Mr. Watkinson said there should be a sense of proportion. What the Commission wanted to do would have cost roughly £180 million each year, and the Government were allowing £170 million a year.

Steel Prices

Mr. George Darling asked the Paymaster General whether he would ask the Iron and Steel Board to review the present prices of steel, in view of the recent increases in share dividends of all the major steel companies, and in particular to reconsider the last permitted increase in prices.

Mr. Renton replied that the Iron and Steel Board kept steel prices continuously under review and he saw no reason to ask them to make a special review on the ground suggested.

Power Station Coal Consumption

Replying to Mr. Sharples, the Paymaster General (Mr. David Renton) said that the net estimated increase

in coal consumption by the Central Electricity Generating Board between the end of this year and 31st December, 1965, was about six million tons, after allowing for increased efficiencies and for the displacement of some of the oldest stations.

The Victoria Tube

Mr. Albu asked the Minister of Transport when construction of the new tube linking north-east London with Victoria and south-west London would start.

Mr. Nugent, Parliamentary Secretary, Ministry of Transport, replied that because the project raised difficult financial problems and the capital which was available to the Transport Commission could be more advantageously used for its modernisation programme, no decision had yet been taken. The scheme would cost £55,500,000 and it was computed to make a loss in any event. Therefore it had to take its turn with other matters which might have greater priority.

Licences for Machinery Imports

Answering a question by Miss Herbison, Mr. John Vaughan-Morgan said that applications for import licences for machinery paid for in dollars were normally approved only when the Board of Trade was satisfied that the machinery would reduce costs and that no alternative United Kingdom machine offering roughly similar advantages was available.

Conservative Labour Committee Discusses E.T.U.

Among Conservative back-benchers some alarm has been caused by the recent revelations about the activities of the leaders of the Electrical Trades Union, and not a few are demanding that there shall be legislation which would enable the Government to appoint a board of inquiry to investigate complaints made against the conduct of a trade union—legislation which might be on the lines of the Companies Act.

Much interest focused last week upon the meeting called by the Conservative Party Labour Committee and addressed by the Minister of Labour, Mr. Iain Macleod. About 70 attended. The Minister's main task seems to have been to calm those members of the party who want prompt Government action. He is reported to have convinced them that, against the background of present Government—trade union relations, the best course was to allow the Trade Union Congress to handle the matter. He believed that this was not the time for the Government to step in to influence the T.U.C. and that the remedy for defects in the E.T.U. rules and organisation must rest upon the collective good sense and influence of trade unions generally, and of E.T.U. members in particular.

The idea of having a judicial inquiry was still pressed by some back-benchers, but after further discussion they appear to have come round to the Minister's way of thinking and agreed to wait to see if any action were taken by the T.U.C. Mr. Ray Mawby, who is joint honorary secretary of the Labour Committee, and a member of the E.T.U., is reported to have told the committee that his experience of the Union convinced him that a judicial inquiry would probably be abortive because of the extraordinary complexity and flexibility of its rules. He preferred that the T.U.C. should be allowed to judge the situation now that the facts were known, and then to consider whether the movement's interests as a whole were not being jeopardised by the actions of the E.T.U. They might decide, he suggested, that unions affiliated to Congress should observe certain standards of conduct in their affairs; if the E.T.U. did not comply the T.U.C. might then encourage E.T.U. members to join other unions.

The committee decided to return to its consideration of the matter after the Christmas recess.

Organisation of A.E.A. Industrial Establishment

AS a result of the recent mishap at Windscale the Government appointed a Committee under the chairmanship of Sir Alexander Fleck to examine and report upon certain aspects of the Atomic Energy Authority's organisation. The first of the Committee's three reports, published last week as a White Paper (Cmd. 338, H.M. Stationery Office, 2s), states that within the Authority's Industrial Group there is a shortage of technical staff which has imposed great strain upon the Group's resources.

Stating that the primary tasks of the Group are to ensure that plant is safely and efficiently operated and that the first stations in the nuclear power programme are so designed and operated as to ensure maximum efficiency and safety, the Committee considers that it may be necessary for the Authority to concentrate development work on few projects. Particular attention is drawn to the need for the utmost care in respect of the Dounreay fast reactor; it is recommended that a new post of director of that establishment should be created. Another recommendation is that a separate works general manager should be appointed for Chapelcross.

Surveying conditions which may be retarding recruitment of technical staff by the Authority, the Committee criticises the methods of assessing salaries. Although it recommends a number of alterations in details of the organisation, the Committee thinks that there should be no major changes; the essential unity of the Industrial Group should be maintained.

Next Week's Events

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

Wednesday, 1st January

HARRINGAY.—Queen's Head, 677, Green Lanes, 7.45 p.m. A.S.E.E. North London Branch. "Electrical Engineers' (ASEE) Exhibition 1957 Film."

HOVE.—New Imperial Hotel, First Avenue, 7.30 p.m. A.S.E.E. Brighton, Hove and District Branch. "The Parks and Gardens of Brighton."

LEICESTER.—Bell Hotel, 7 p.m. Incorporated Plant Engineers, Leicester Branch. "Smoke Abatement," by S. N. Duguid.

LONDON.—1, Birdcage Walk, Westminster, S.W.1, 6.45 p.m. Institution of Mechanical Engineers (Steam Group). Discussion on "Availability of Power Plant."

PORTSMOUTH.—At the C.E.A., 6.30 p.m. I.E.E. Southern Centre. "Cathodic Protection," by L. B. Hobgen, K. A. Spencer and P. W. Heselgrave. (Joint meeting with the Southern Association of the I.C.E.)

PRESTON.—R.A.F.A. Club, East View, 7.30 p.m. A.S.E.E. Preston Branch. "Railway Electrification," by K. Taylor.

Thursday, 2nd January

NOTTINGHAM.—Demonstration Theatre, East Midlands Electricity Board, Smithy Row, 6 p.m. I.E.S. Nottingham Branch. "Lighting from the Contractor's Point of View," by N. C. Slater.

SOUTHAMPTON.—Polygon Hotel, 8 p.m. A.S.E.E. Southampton Branch. "Traffic Control," by E. Bailey.

Friday, 3rd January

BRISTOL.—Grand Hotel, Broad Street, 8 p.m. A.S.E.E. Bristol and West of England Branch. "Reinforced Concrete Construction," by J. Barrett, followed by a film "Prestressed Concrete."

CAMBRIDGE.—Dorothy Restaurant, 7 for 7.30 p.m. I.E.E. East Anglian Sub-Centre. Annual dinner and dance.

COVENTRY.—Craven Arms. A.S.E.E. Coventry Branch. Annual dinner and social evening.

LIVERPOOL.—9, The Temple, 24, Dale Street, 7.30 p.m. A.S.E.E. Liverpool Branch. "Power Factor Correction," by F. T. Bartho.

Department of Electrical Engineering, University of Liverpool, 7 p.m. Institute of Physics, Liverpool and North Wales Branch. "Radio Astronomy," by Dr. H. P. Palmer.

LONDON.—Pepys House, 14, Rochester Row, Westminster, S.W.1, 7 p.m. Junior Institution of Engineers. Film evening: "X-Ray Crystallography," "Cables Round the World," and "Diamond Dies for Wire Drawing."

PLYMOUTH.—Central Hall, 3 p.m. I.E.E. South-Western Sub-Centre. "Lighting," by Professor H. Cotton.

Saturday, 4th January

BIRMINGHAM.—Birmingham Electric Club. Children's party.

HAMMERSMITH.—Clarendon Restaurant. A.S.E.E. West London Branch. Annual dinner and dance.

A.C. MOTOR CONTROL

METHODS OF BRAKING AND INCHING

By J. L. WATTS, A.M.I.E.E.

ON many electrical machines maximum output is obtained when the machine can rapidly be brought to a standstill and reversed, while safety considerations may demand that the machine can be stopped rapidly in an emergency. For some purposes it is also required that the machine shall be capable of being " inched," or moved in short jerks, in order that its moving parts can be set in a particular position.

Friction Brakes

A friction brake is the only type of brake which can hold a machine at rest against a disturbing force, but in order to maintain the braking efficiency these brake units must be adjusted from time to time to compensate for wear, and the friction surfaces must be kept free from dirt, oil or water. A friction brake may consist of a band, or more often shoes having friction linings, which are pressed around a drum by means of a weight or springs when the brake-release mechanism is de-energised.

The kinetic energy of the revolving parts is then converted into heat at the friction surfaces. This kinetic energy is proportional to the mass of the moving parts and the square of their velocity. In the case of revolving parts the kinetic energy is proportional to the mass of the part, the square of the angular velocity, and to the square of the radius of gyration at which the mass is assumed to act. Thus a comparatively high braking torque may be required to bring a drive to a standstill quickly if the moving parts are heavy, are revolving at high speed, or have a large diameter.

The horsepower rating of a brake is equal to the ratio $\frac{\text{braking torque} \times \text{h.p. rating of the motor.}}{\text{full-load torque}}$ The braking torque of a friction brake in pounds-feet is equal to $\frac{\text{h.p.} \times 5{,}250}{\text{r.p.m.}}$ and is determined by the product of the radius (r) of the brake drum, the pressure (P) on the friction linings, and the coefficient of friction (μ) between the linings and brake drum. After cutting off the power to a drive and applying the brake, the number of revolutions which the brake drum makes before coming to rest is proportional to the ratio $\frac{\text{kinetic energy,}}{P \times r \times \mu}$ and the time taken to bring the drive to a standstill is proportional to $\frac{\text{kinetic energy,}}{P \times r \times \mu \times N}$ where N is the initial speed of the brake drum.

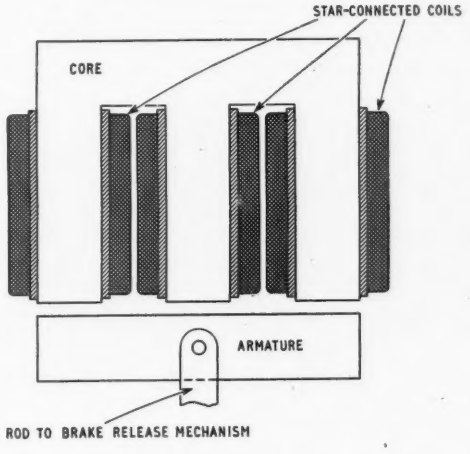


Fig. 1.—Arrangement of a three-phase tractive brake-release electromagnet

In the design and selection of a friction brake many considerations are involved, such as the kinetic energy to be dissipated, the mechanical stresses in the various parts, the initial speed, and the time required to stop the drive, as well as the frequency of operation and the permissible temperature rise of the friction linings. For cranes and lifts the braking torque required may be between about 100 and 125 per cent of the full-load torque, a greater braking torque usually being required for stopping a machine in an emergency. The kinetic energy of the brake drum itself can be reduced by limiting its diameter but, with a given coefficient of friction, a greater pressure will then be required on the brake shoes for a given braking effect. The pressure per square inch of friction surface must, however, be kept within limits.

Electromagnetic Brakes

An electromagnetic brake used with an a.c. motor is usually shunt connected across the terminals of the motor so that the brake coil is energised to release the brake as soon as the motor is energised, and a separate switch is not required. A single-phase tractive electromagnet may be used with a single-phase or a polyphase motor, or a polyphase tractive brake electromagnet may be used with a polyphase motor. A considerable current is taken by a shunt-connected a.c. brake coil at the instant of switching the supply on to the coil, when there is maximum air gap in the magnetic circuit, the coil current falling, and the magnetic pull increasing, as the air gap is closed to release the brake. For this reason short-travel tractive electromagnets are commonly employed for releasing a.c. brakes.

Shading bands are fitted round part of the pole faces of a single-phase electromagnet to delay the cycle of magnetic flux in the encircled portion, in order that there will be flux in some portion of the pole face during all parts of the a.c. cycle. Shading bands are not required in a polyphase tractive electromagnet, as indicated in Fig. 1, the polyphase type giving a more constant pull than a single-phase magnet. A dashpot may be provided to cushion the upward movement of the armature at the end of the brake-release stroke. Such a dashpot would be used with a piston having a valve which opens to allow quick downward movement to release the brake when the coils are de-energised.

Solenoid brake release mechanism is also employed with single-phase and polyphase motors. The coil may have a laminated magnetic circuit so that it can be used

on either a.c. or d.c. For use on d.c. one section only of the coil may be energised at the instant of switch on, to provide the considerable ampere-turns required to produce the pull when the reluctance of the magnetic circuit is high due to the air gap, an automatic switch connecting the other coil section in circuit when the plunger has pulled home and "sealed" the brake free. The ampere-turns of an a.c. electromagnet coil are automatically reduced as the inductance of the coil falls when the magnetic circuit closes to release the brake. Table 1 refers to one range of solenoid-released brakes. Electromagnetic brakes should release the brake on 90 per cent of rated voltage, and should hold the brake shoes clear if the voltage falls to 50 per cent of rated value.

Motor-Operated Brake Release

A friction brake which is applied by means of a spring or weight may also be released by means of a single-phase or polyphase torque motor, which is connected to the terminals of the main driving motor. Thus, when the driving motor is switched on, the torque motor also is energised and its pinion operates a toothed rack which moves the brake shoes clear of the brake drum. Excessive stresses on the moving parts of the brake and torque motor are avoided by the use of a special clutch on the shaft of the torque motor. The torque motor remains energised and stalled during the whole of the brake-release periods, and is designed so that it does not overheat under these conditions. This type of brake-release mechanism does not require a high power, but it may release the brake rather less rapidly than an electromagnetic brake.

Electro-Hydraulic Release Gear

A friction brake may be released by means of hydraulic pressure applied to a piston. This system is embodied in the "thrustor" which employs a centrifugal pump driven by a small electric motor. When the latter is switched on the centrifugal pump rapidly builds up fluid pressure which moves the piston to release the brake. The "thrustor" motor takes very little power and exerts a constant force on the brake-release mechanism. The device cannot be damaged by overload as the pump impeller would then merely spin round in the oil without moving the piston.

Dynamic Braking

For some purposes it is merely required to be able to reduce the speed quickly to a lower value, or to bring the motor to a standstill, and it is not necessary to hold the machine at rest against a disturbing force. There are various ways in which dynamic braking can be employed for this purpose, without the use of friction brakes and mechanical devices. With these systems, therefore, there are no mechanical devices requiring adjustment and maintenance; but extra switching is required, the braking torque is not constant and falls as the speed is reduced.

TABLE I.—RATINGS AND DATA OF ONE RANGE OF BRAKE-RELEASE SOLENOIDS

Frame size	Gross pull at 85% volts with shunt-wound coils continuously rated		Stroke (in)	Weight of plunger (lb)	Volt-amperes on a.c. supply		Watts on d.c. supply	
	a.c.	d.c.			kick	sealed	kick	sealed
1	2½ lb	3 lb	1	0·33	500	60	450	12·5
2	9 lb	11 lb	1½	1	2,095	165	825	15
3	20 lb	36 lb	1¾	2·25	5,450	390	2,725	30
4	40 lb	42 lb	2	5	13 640	705	3,875	55
5	70 lb	59 lb	3	13	17,450	590	5,575	64

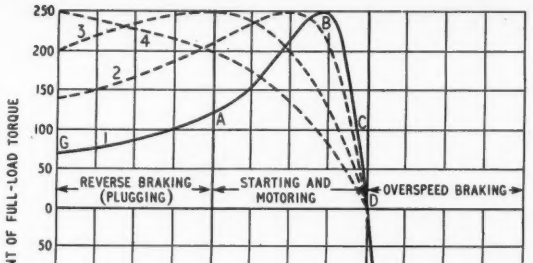


Fig. 2.—Speed/torque curves for three-phase induction motors

In all forms of dynamic braking the motor is used as a generator, the kinetic energy of the drive being converted into electrical energy during braking.

Overspeed Braking

The curve ABCD in Fig. 2 shows the speed/torque characteristics of a particular three-phase induction motor, of given rotor circuit resistance, from being started up to running on no load. After switching on, the motor torque rises from the initial value A to the peak value B, and then falls as the motor continues to accelerate. The portion C-D of the curve represents the normal working range of the motor between no-load and full-load torque.

The portion DEF of the curve also shows that if, while the stator windings remain connected to the a.c. mains, the motor is driven at more than synchronous speed, by means of its load or otherwise, it develops a negative or braking torque. This is due to the fact that the rotor conductors are then revolving faster than the revolving stator flux, and thus cutting the flux in the opposite direction to normal, with consequent phase reversal of the induced rotor current.

The braking torque is proportional to the product of the strength Φ of the stator flux, the rotor current I_r, and the power factor $\cos \Theta_r$ of the rotor circuit. This torque is thus proportional to $\frac{\Phi \times s \times R_r}{R_r^2 + (sX_r)^2}$ at a given speed, where R_r is the resistance of the rotor circuit, X_r the reactance of the rotor circuit and s is the fractional negative slip; s is equal to $\frac{N - N_s}{N_s}$, N_s being the synchronous speed of the motor and N being the actual speed at which the motor is running.

The motor then acts as an asynchronous generator, the power regenerated by the braking effect being returned to the a.c. supply mains. As the speed increases over synchronous value, at which speed the induced rotor current is zero, the induced rotor current increases, and the braking torque also increases up to a certain speed, as shown at E in Fig. 2. If the speed rises still further the braking torque decreases due to the increased slip frequency (sf) of the induced rotor current increasing the reactance sX_r of the rotor circuit,

with reduction of rotor circuit power factor. This overspeed braking effect is quite automatic, but its application is limited to cases where the motor may be driven at more than synchronous speed by its load. The braking torque diminishes at very high speeds and ceases when the speed has fallen to synchronous speed. A similar braking effect is obtained when switching the stator windings of a pole-changing motor over to a lower speed, the braking effect ceasing when the speed of the motor has fallen to the lower synchronous speed.

D.C. Injection Braking

Dynamic braking of an induction motor can be applied practically to zero speed, however, by using additional switchgear to switch the stator windings off the a.c. mains and on to a source of direct current. The magnetic flux produced by the current in the stator windings is then stationary and is cut by the rotor conductors as the motor slows down. So long as the motor is driven by the kinetic energy of its rotor and the coupled drive it will then act as a generator, the braking effect being created by reaction between the machine's stator flux and the induced rotor current.

The braking torque depends on the speed, the strength of the stator flux, and the rotor current. If required, it can be controlled by varying the value of the injected direct current and/or, in the case of a slip-ring motor, by means of external resistance in the rotor circuit. Under given conditions the braking torque diminishes as the speed falls to zero.

The magnetic field strength produced by the injected direct current is limited by the saturation effect in the iron cores, and the induced rotor current has a demagnetising effect. Thus, with a given d.c. value, the demagnetising effect may reduce the braking torque fairly considerably if the rotor circuit resistors are cut out too quickly. The direct current may be supplied by a rectifier, the output of which is applied to two of the stator terminals. A series transformer in the rotor circuit may be applied to the rectifier too so that the injected current is governed also by the rotor current. In this way the stator flux can be almost independent of the rotor current, and a braking torque equal to full-load torque can be applied at 5 per cent of synchronous speed. D.c. injection gives braking to zero speed with no tendency to reversal at zero speed, and has the advantage that the losses to be dissipated in the rotor circuit during braking are relatively small. This is a point in favour of this method where frequent braking is required.

Fig. 3 shows a circuit which may be used. When the " start " push-button is pressed the coil A of the line contactor B is energised to start the motor by connecting its stator windings to the a.c. supply, the contacts C being closed to keep the coil A energised when the " start " push-button is released. The accelerating controls of the rotor circuit contactors are not shown in Fig. 3. Pressure on the " stop " push-button de-energises the coil A so that the line contactor opens. As it does so the contacts D close to energise the coil F through the centrifugal switch E, the latter being closed when the motor runs normally. The coil F then closes the contacts G to supply the primary windings of the transformer J from the a.c. supply, and the contacts H are closed to connect the output of the rectifier K to the stator windings of the motor. As the machine comes to a standstill the contacts of the centrifugal switch E open to de-energise F and in this way cut off the d.c. excitation.

Braking by Plugging into Reverse

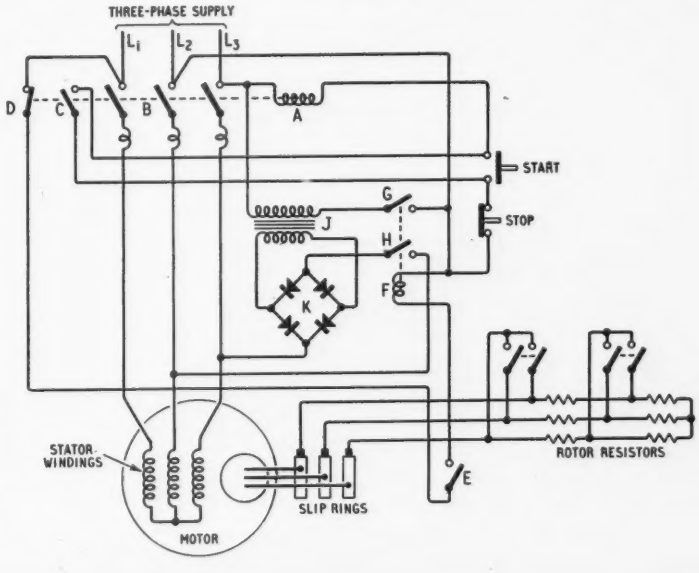
The curve G-A in Fig. 2 shows the braking torque which may be exerted when a running polyphase a.c. motor, with given rotor circuit resistance, is plugged into reverse. The phase rotation of its stator magnetic flux is then reversed so that the motor is then running at a negative speed with respect to the stator flux and the rotor conductors cut the stator flux at high speed. E.m.f. and current of more than mains frequency are then induced in the rotor conductors. As the motor is braked to a standstill the induced rotor e.m.f. falls but the reduced rotor circuit frequency causes increase of the rotor circuit power factor, so that the braking torque rises as the motor slows down.

The curves 2, 3 and 4 in Fig. 2 show the effect of increase of rotor circuit resistance. It will be noted that increase of rotor circuit resistance, up to a certain maximum value, causes increase of braking torque; this is due to the resultant increase of rotor circuit power factor.

Braking by plugging has the advantage that the load on the a.c. mains is balanced and a high braking torque can be obtained, but there are considerable losses in the rotor circuit during braking, which might cause overheating if the braking is very frequent. Increase of rotor circuit resistance increases the braking torque but reduces the rotor circuit losses.

If the braking switch is left closed the motor will accelerate in the reverse direction after passing through zero speed; on the other hand if the braking switch is opened too soon the braking torque will cease and the motor will then merely coast to a standstill under the frictional losses in the bearings, etc. An automatic switch can, however, be fitted to de-energise the braking switch as soon as the motor has reached zero speed. Fig. 4a shows the control gear for a three-phase squirrel-cage motor which is braked by plugging. When the " start " push-button is pressed the coil A of the main

Fig. 3.—Circuit for braking a three-phase slip-ring motor by d.c. injection



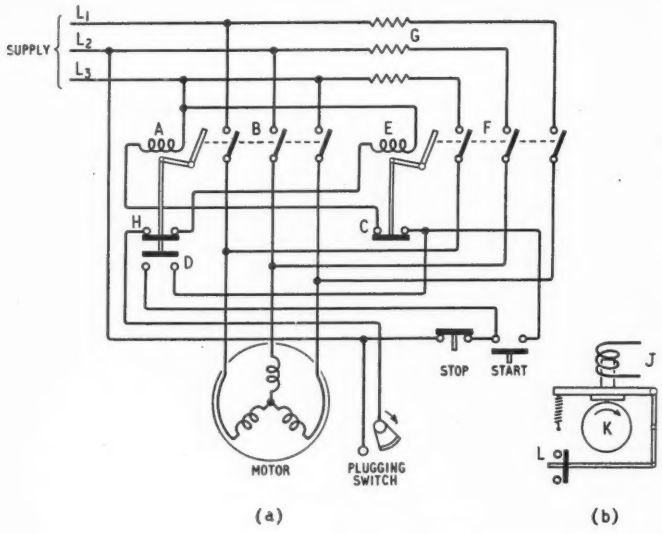


Fig. 4.—Circuit diagram for braking a three-phase squirrel-cage motor by plugging

contactor B is energised and the motor starts up, the contacts D closing to keep A energised when the "start" push-button is released.

When the motor starts, the contacts of the plugging switch are closed, this switch being coupled to the motor shaft. Thus, when the "stop" push-button is pressed and the contacts H are reclosed by the de-energised coil A, the coil E of the plugging contactor F is energised through the plugging switch and the contacts H. The plugging contactor then connects the stator windings to the three-phase supply with reversed phase rotation through the resistors G, used to limit the motor current during braking. As soon as the motor has reached zero speed the plugging switch opens to de-energise the coil E and prevent reversal of the motor.

Another type of plugging switch is shown in Fig. 4b. When the starting contacts are closed auxiliary contacts close to supply the solenoid coil J, which then holds a friction arm clear of the wheel K with the contacts L open. When the main contactor is de-energised the current is switched off the coil J also; the friction arm then drops on to the wheel K and the contacts L close to energise the coil of the plugging contactor. After passing through zero speed a very slight angular movement in the reverse direction will cause the friction wheel K to open the contacts L to de-energise the coil of the plugging contactor.

When an ordinary single-phase induction motor is running, with the starting windings de-energised by the open contacts of the centrifugal switch, the direction of rotation depends only on the direction in which it was started. Similar remarks apply to most capacitor types of motors and to repulsion-start induction motors. It is not practicable to reverse such types of motor by simple switching.

It is, however, possible to use a specially wound, electrically-reversible, intermittent-rated high-torque capacitor motor which has similar starting and main windings. Fig. 5 shows the connections of such a machine, which is wound for four poles. This motor can be reversed and/or braked by plugging by using a simple single-pole two-way switch as shown. When the switch S is on the contact F as indicated the stator windings A_1 A_2 A_3 and A_4 are connected directly across the supply and act as the main windings. The stator windings B_1 B_2 B_3 and B_4 are then connected to the supply through the capacitor C and act as the auxiliary windings. When the switch is thrown over to the contact R the windings B_1 B_2 B_3 and B_4 are connected direct to the supply and act as the main winding, while the windings A_1 A_2 A_3 and A_4 are connected through the capacitor and act as the auxiliary windings to reverse the motor.

An ordinary repulsion motor has a wound rotor connected to a commutator on which ride permanently short-

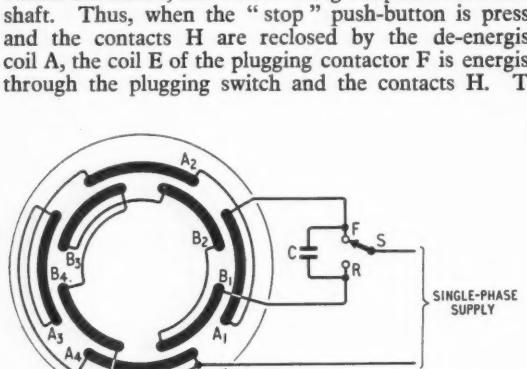


Fig. 5.—Connections of an electrically-reversible high-torque capacitor motor

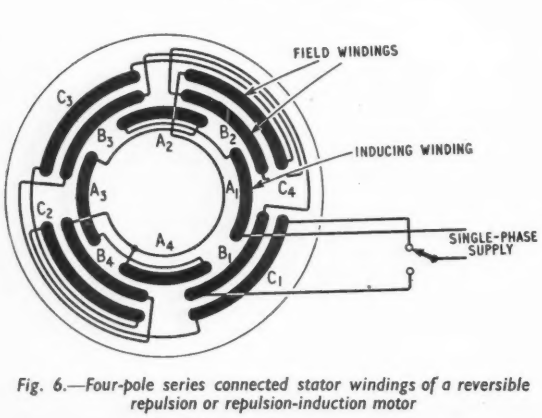


Fig. 6.—Four-pole series connected stator windings of a reversible repulsion or repulsion-induction motor

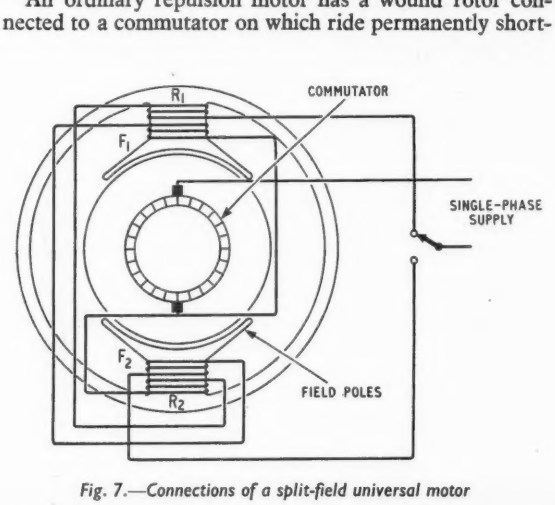


Fig. 7.—Connections of a split-field universal motor

circuited brushes. A repulsion-induction motor is similarly arranged, but has an additional squirrel-cage winding in slots below the insulated rotor winding. These two types of motor can only be reversed by switching if they have been wound with separate inducing and field windings on the stator. If they are thus wound they can be reversed and/or braked by plugging by using a double-pole two-way switch to reverse the connections to the inducing windings.

Fig. 6 shows the connections of a special repulsion motor, or a repulsion-induction motor, having two sets of field windings, one for either direction of rotation, and an inducing winding. Such motors can be reversed and/or braked by plugging, by means of the single-pole two-way switch shown in the diagram. A plain repulsion motor with these connections will brake more rapidly than will a repulsion-induction motor.

Plugging of Single-Phase Series Motors

A single-phase series (universal) motor can be reversed by reversing the connections to the field windings. However, if the brushes are set backward from neutral for one direction of rotation they will then be set in advance of neutral for reverse rotation and sparking may result. Thus a reversible series motor should be designed for operation with the brushes in neutral position. Such a motor may be reversed and/or plugged by using a double-pole two-way switch to reverse the connections to the field windings.

As is exemplified in Fig. 7 some series motors are obtainable which have split field windings R_1 R_2 and F_1 F_2. Such a motor can be reversed and/or braked by plugging by using a single-pole two-way switch so that either one or other of the sections of field windings can be used. If required, the braking effect could be controlled by connecting a resistor in series with the motor during plugging.

Inching

A polyphase induction motor can be jerked round by closing the stator switch momentarily. However, since the initial current taken by the stator windings when switched on to the supply with the motor at rest is much greater than the full-load current, this treatment may soon result in damage to the contacts if not specially designed to interrupt such high currents. Furthermore, it is difficult to control the motor in this way.

In the case of a coil-operated push-button controlled starter the inching push-button should have one set of contacts which close to energise the stator contactor when pressed, and another set of contacts which open to cut out of circuit the hold-on contacts and any accelerating contactors. As shown in Fig. 8 the motor torque and the stator current can be controlled by connecting additional resistance in the rotor circuit during the inching of the machine.

Inching of a Polyphase Motor by D.C. Injection

The rotating magnetic flux in a polyphase induction motor is, of course, automatically produced by connecting the distributed phases of the stator windings to the phases of the supply, the synchronous speed of the motor being equal to the supply frequency divided by the number of pairs of poles for which the motor is wound. A revolving magnetic flux can also be produced by injecting direct current into different parts of the stator windings at different instants. This method can be used to inch a motor.

Fig. 9a illustrates a switch which can be used for this purpose. As the moving contacts are turned from one position to the next the magnetic flux moves round the motor, as indicated in Figs. 9b to 9g inclusive. The moving flux induces current in the rotor conductors which reacts with the moving flux to create torque in the direction of rotation of the flux. In this way the motor can be turned through part of a revolution or more as required. If required the switch can also be turned continuously so that the motor runs at crawling speed, exerting about full-load torque.

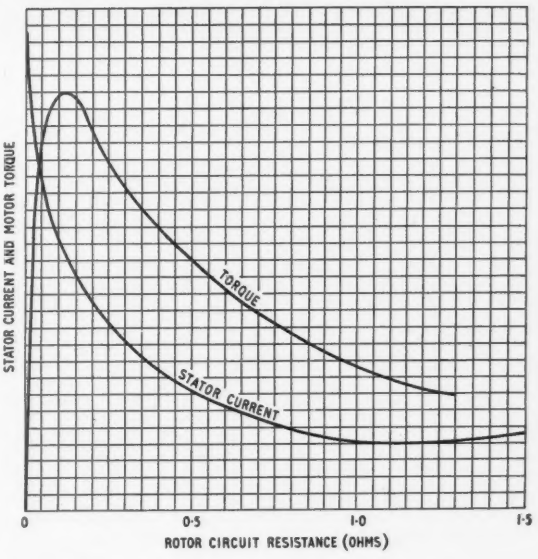


Fig. 8.—Relation between rotor circuit resistance, starting torque and initial stator current

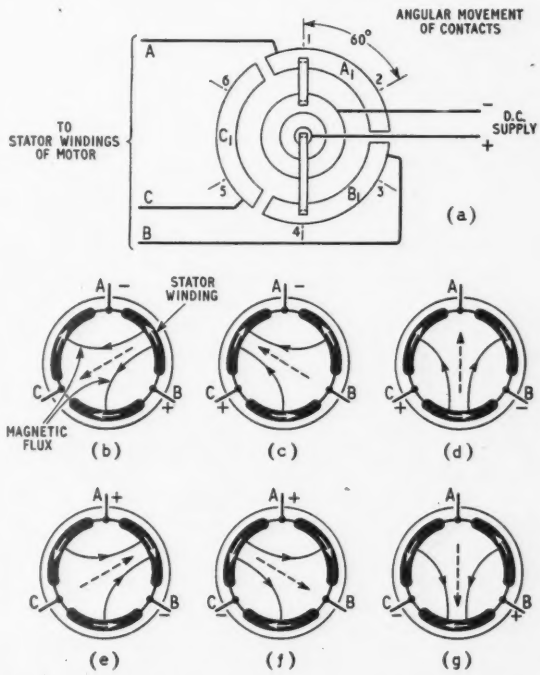
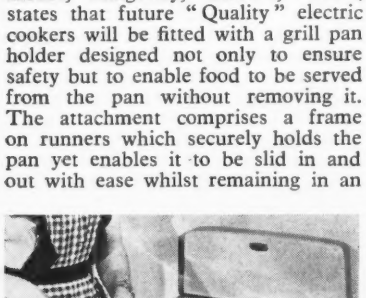


Fig. 9.—Inching of a three-phase induction motor by d.c. injection

NEW ELECTRICAL EQUIPMENT

Grill Pan Safety Attachment

A recent announcement from the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2, states that future "Quality" electric cookers will be fitted with a grill pan holder designed not only to ensure safety but to enable food to be served from the pan without removing it. The attachment comprises a frame on runners which securely holds the pan yet enables it to be slid in and out with ease whilst remaining in an untiltable position. The new grill pan holder will be fitted as standard at no extra cost.



Grill pan safety attachment fitted to the G.E.C. "Quality" cooker

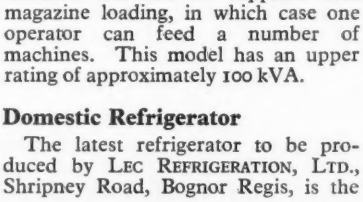
Indexing Welding

The latest addition to the range of indexing welders made by SCIAKY ELECTRIC WELDING MACHINES, LTD., Falmouth Road, Slough, Bucks., is suitable for spot or projection welding or hot riveting. The articles catered for by this model, PAGM 10, are small components such as electrical parts, contacts, transistors, etc. The table of the machine can be fitted with any reasonable number of jigs or stations and it is driven and indexed by an electric motor giving, through a gear box, a range of welds up to 50 per minute. The air operated pressure head is fitted with a damper to reduce shock on the down stroke, this being interlocked with the general mechanism, so that the gear is in the clear position when the table indexes.

The welding current supply and control is made in accordance with the work to be accomplished. Because the work is usually small and therefore the welding sensitive, an ignitron contactor is employed together with electronic timing, usually of a synchronous nature. Various types of unloading mechanism are used, depending on the nature of the job, either electrical, mechanical or pneumatic, or a combination of these. Normally the machines call for one unskilled operator only to load the pieces into the welding jigs, but the machine can also be supplied with magazine loading, in which case one operator can feed a number of machines. This model has an upper rating of approximately 100 kVA.

Domestic Refrigerator

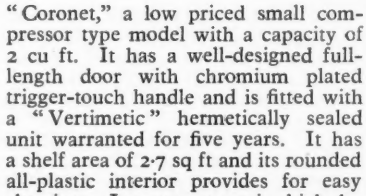
The latest refrigerator to be produced by LEC REFRIGERATION, LTD., Shripney Road, Bognor Regis, is the "Coronet," a low priced small compressor type model with a capacity of 2 cu ft. It has a well-designed full-length door with chromium plated trigger-touch handle and is fitted with a "Vertimetic" hermetically sealed unit warranted for five years. It has a shelf area of 2·7 sq ft and its rounded all-plastic interior provides for easy cleaning. It measures 27in high by 21½in wide by 20½in deep and is finished in white stoved enamel. The price is £28 plus £12 14s purchase tax in the United Kingdom. In addition there is a service fee of £2.



Lec "Coronet" 2 cu ft refrigerator

Oil-Tight Control Units

The range of heavy duty oil-tight control units offered by the IGRANIC ELECTRIC CO., LTD., Bedford, includes push-buttons, indicating lights and selector switches—in a compact form that requires less than 1¼in of back panel space. The contact block of each unit contains two circuits which are mechanically and electrically isolated and it can be obtained with both circuits normally open, both normally closed, or one normally open and one normally closed. A further increase of flexibility can be obtained by stacking the blocks in twos, threes or fours.



Igranic oil-tight control unit

The contact block is moulded of phenolic material with terminals rigidly staked for performance. Buttons are moulded of smooth coloured plastic and for complete oil-tightness there is a neoprene seal behind each button that will successfully withstand countless flexings as the buttons are depressed. Six oil drainage vents prevent oil accumulation. A gasket provides a full oil seal between operator and panel.

Decorative Lighting Set

The new "Gala" lighting set recently introduced by EKCO-ENSIGN ELECTRIC, LTD., 45, Essex Street, London, W.C.2, comprises twelve watertight rubber lampholders and twelve assorted coloured lamps. The lamps, all with a voltage range of 200/250 V, are internally coloured and packed twelve to a carton—two each of six different colours. The pink, yellow and amber lamps are rated at 25 W and red, blue and green at 40 W. The lampholder string is 27ft in length with a plug at one end and a watertight socket at the other. Up to six strings may be connected together. The price of a box of twelve lamps is £1 6s 6d plus 4s 6d purchase tax in the United Kingdom and the lampholder string is priced at £3 15s.

Brush Holders

It is announced that the MORGAN CRUCIBLE CO., LTD., Battersea Church Road, London, S.W.11, has secured the rights to manufacture brush holders to British Patent 674796. This patent, owned by Signor Ing. G. Giambonini, Bellinzona, Switzerland, covers a novel type of brush holder pressure finger, for use particularly with split brushes, and the associated brush holder. The arrangement is applicable principally to traction motors, but can be applied to any type of machine where maximum brush stability is required.

This type of brush holder has been tested on the Swiss Federal Railways

Giambonini brush holders

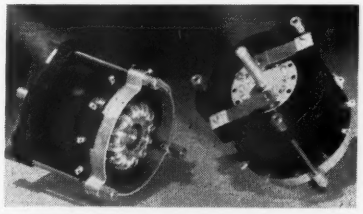
with such good results that the decision was taken last year to convert the motor brush holders on all the existing locomotives to the new system, and all motors ordered since that date have been fitted with the Giambonini holder.

The advantages of these holders are improved condition of commutators with a corresponding decrease in maintenance costs and out-of-service time for commutator turning, and reduction in brush wear. It is claimed that on the $16\frac{2}{3}$ c/s a.c. traction motors on the Swiss Federal Railways, the period between successive reconditioning of the motor commutators has increased five to ten times and brush life has been almost doubled.

Instrument Switch

The latest instrument switch to be introduced by W. G. PYE & CO., LTD., Cambridge, has successfully performed 17 million operations, which is equivalent to about thirty years of service, and the performance has remained virtually unchanged. The overall switch resistance is about 0·7 mΩ and the variation of contact resistance is ±20 μΩ. The overall resistance drift during the life of the switch is ±50 μΩ. The thermal e.m.f. is 0·008 μV/deg C with uniform change of temperature, while the maximum temperature gradient across the switch is 0·025 μV/deg C.

The stationary contacts are mounted in a strong insulating frame and the set of brushes makes a bridge contact between pairs of adjacent bars in a symmetrical manner. The brush itself is composed of several contact springs each of which is independent of the



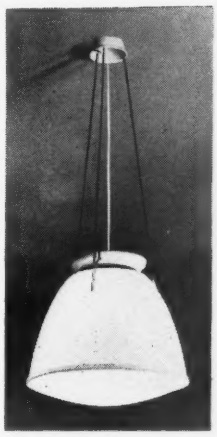
Pye high-stability instrument switch

others and unrestricted in its movement. Low and consistent contact resistance is achieved without high contact pressure and mechanical wear. The moving contacts are totally enclosed.

Non-Corrodible Lighting Fittings

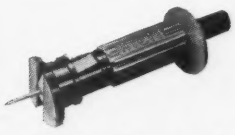
Two new non-corrodible lighting fittings specially designed for use in food factories and other installations where corrosive vapours are present are now being marketed by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2.

The 150/200 W fitting (F.64532) measures 12½in high by 14in wide and the 300/500 W fitting (F.64533) is 17in high by 18½in wide. The reflector of each is formed in opal "Perspex" and is sealed into a front cover of

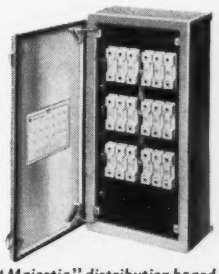


Left: G.E.C. F.64532 non-corrodible lighting fitting

5ft 80 W dust-proof "Gold Label" fluorescent fitting (Stella Lamp Co., Ltd.)



"Hilti" stud fastening tool (Wordrew, Ltd.)



"Majestic" distribution board by Bill Switchgear

clear "Perspex," a combination which ensures adequate upward illumination while maximum light is directed downwards.

Each fitting is suspended by three "Terylene" cords (each having a breaking strain of about 250 lb) which are secured to ⅛in p.v.c. ceiling plates. To facilitate height adjustment three holes are provided for each cord, which is threaded through them so that it forms a self-locking loop. In severe corrosive atmospheres the surplus cord can be tied over the roof truss, or above a false ceiling, as a secondary fixing.

The fittings are priced at £9 and £13 6s each.

Power Oxide Resistors

Resistors recently placed on the market by the WELWYN ELECTRICAL LABORATORIES, LTD., Bedlington, Northumberland, are medium power components designed specifically for use in domestic radio and television receivers, but their properties make them suitable for other applications where a low cost resistor is required.

The resistance element is composed of a metal oxide which is bonded to a porcelain rod at red heat. This results in a resistor which is extremely rugged. To prevent contamination of the resistance element due to handling it is coated with a silicone base compound.

Connection to the resistance element is made through silver plated end caps which ensure a low contact resistance and freedom from noise. The terminal wires are riveted into the end caps before they are fitted. The resistance values available are 10 Ω to 10 kΩ at 3 W, 20 Ω to 20 kΩ at 4 W and 25 Ω to 20 kΩ at 8 W. The effects of inductance and self-capacitance can be neglected when used at frequencies up to 10 Mc/s.

Distribution Boards

A new range of modern styled fuseboards is offered under the trade name "Majestic" by BILL SWITCHGEAR, LTD., Aston Lane, Perry Barr, Birmingham, 20. The current ratings available are 15/20 A, 30 A and 60 A, all with interchangeable h.r.c. or arc-damping type fuses. Double-pole, triple-pole, and triple-pole with neutral models are available in all current ratings. These distribution boards are finished in a durable stoved silver grey hammered enamel matching "Majestic" cubicle switchboards.

Lighting Fittings

The STELLA LAMP CO., LTD., 160, Shaftesbury Avenue, London, W.C.2, has recently extended its range of tungsten and fluorescent lighting fittings and associated control apparatus to include a new series of "Gold Label" de luxe fluorescent fittings, as well as a number for use with snap start fluorescent lighting which are added to the "Blue Label" range.

Tungsten floodlight fittings now include a weatherproof dispersive floodlight, a robust projector for narrow beam floodlighting and a fitting suitable for use with 140 W sodium lamps.

A wide choice of industrial reflector fittings is also being marketed. The range of control apparatus introduced covers capacitors and ballasts for fluorescent, mercury and sodium discharge lamps.

Stud Fastening Tool

Special threaded studs and nails can be driven into concrete, brick and steel by the use of the "Hilti" hand tool which has just been introduced into this country by WORDREW, LTD., 173, Princess Street, Manchester, 1. This new process, similar to the explosive cartridge driven tool but using only a hammer, is claimed to be possible because of the high tensile steel, conic shaft, ballistic point of the studs and pins, coupled with a high standard of manufacture. With a few strokes of a 3 lb hammer it is claimed that studs can be permanently fixed within 30 seconds. When fixed, a pull-out resistance of 400 lb is claimed for the studs, which is considered to be sufficient for fixing cable, conduit, electrical fittings, etc. The price of the tool is £3 5s.

INDUSTRIAL NEWS

Telephone Equipment Manufacture in South Africa

A *Reuter* message from Pretoria states that contracts were signed there on 18th December between the South African Government and three companies—the Automatic Telephone & Electric Co., Ltd., and Siemens Bros. & Co., Ltd., of the United Kingdom, and Siemens & Halske, of Germany—for manufacture in the Union of telephone equipment, exchanges and long-distance communication equipment. The Post and Telegraphs Minister stated that this will cut South Africa's imports of such equipment, valued at £2,500,000 annually, and probably allow the country to overcome its shortage of telephones by 1959.

The E.T.U. Dispute

Comments on the recent trouble relating to elections to the Executive Council of the Electrical Trades Union appear in the current issue of the Union's journal, *Electron*. It is asserted that "a member, or members, of this Union, presumably with vested interests and/or political axes to grind, sought and obtained the use of the Press to air publicly their views." The allegations of these members are said to be completely untrue and without foundation and an attack is made on the Press generally for its "speculation, distortion and innuendo."

High Energy Laboratory

The Governing Board of the National Institute for Research in Nuclear Science announces that W. E. Chivers & Sons, Ltd., have been awarded a £1 million contract for the construction of the main buildings for the Institute's new Rutherford High Energy Laboratory on a site adjacent to the Atomic Energy Research Establishment at Harwell. The buildings are to house the new proton synchrotron being built for the Institute (see *Electrical Review*, 20th December, page 1130).

Nigerian Report

A report on the economic and commercial conditions in Nigeria, prepared by Mr. E. I. Oliver, United Kingdom Trade Commissioner in Nigeria, has been published by the Commercial Relations and Exports Department of the Board of Trade (H.M. Stationery Office, 10s net). While the report deals fairly fully with the general economic and commercial trends of Nigeria, the electrical information is mainly confined to a section on developments by the Electricity Corporation of Nigeria. These were dealt with in our issues of 8th February and 21st June last. There are a number of appendices to the report, and one, showing the value and weight of imports of machinery and transport equipment by the country of origin for the years 1954, 1955 and 1956, includes certain electrical equipment.

Mr. Nehru Inaugurates Calcutta Electrification

On 14th December the Prime Minister of India, Mr. Nehru, inaugurated the first electrification scheme on the Eastern Railway of the Indian Railway Board, between Calcutta and Burdwan, 59 miles to the north. The English Electric Co., Ltd., has supplied twelve 3,120 h.p. electric locomotives which are the first to be commissioned in India using 3,000 V d.c. They can haul anything from a 630-ton passenger train (about 14 coaches) at 70 m.p.h. to a 2,300-ton freight train at nearly 45 m.p.h. The locomotives, weighing 112 tons, have been built by the Vulcan Foundry, part of the English Electric Group.

The new electrification in Calcutta has been provided to cater for the greatly increased traffic in the new industrial belt around Bihar and West Bengal, and will later be extended to Moghalsarai.

Paper Mill Steam Supply

A film has just been completed of one of the contracts of J. D. Crozier & Partners, Ltd., consulting engineers. The title of the film is "Project 204," and it concerns the construction and commissioning of a medium pressure steam main and condensate return between a paper mill and a board mill. The length of the 16 mm film is 700ft and it is available on free loan to technical societies and similar bodies. Applications should be made to Mr. T. B. Sansom, 42, York Place, Edinburgh, 1.

Trade with Rhodesia and Nyasaland

The values of the imports of the chief groups of electrical goods into Rhodesia and Nyasaland last year are shown in the accompanying table.

Product	1955 £(000)	1956 £(000)
Motors and parts	441	504
Transformers	595	808
Switchgear	1,032	1,220
Other machines	1,921	1,545
Batteries	404	469
Cables and wires	1,709	2,760
Lamps, bulbs	149	192
Telephone and telegraph equipment	481	602
Radio sets and radio gramophones ...	607	796
Domestic refrigerators and parts	780	768
Stoves, cookers and hot-plates	268	309
Washing machines ...	112	144
Other domestic appliances	231	303
Other electrical goods and appliances	1,408	1,593

The United Kingdom was the principal supplier in nearly every category, and was followed by South Africa; some electrical equipment was also imported from the United States, the Netherlands, Sweden, Italy and West Germany.

Despite the fall in the price of copper, the major export, the economic outlook for the Federation continues favourable. The current four-year Federal Government development plan provides for a total expenditure of £138 million. The largest items include £54 million for the Kariba scheme, £39 million for the railways, £5·7 million for telecommunications and £5·6 million for the Southern Rhodesia Electricity Supply Commission.

Telecommunications Contract

A contract has been awarded to Marconi's Wireless Telegraph Co., Ltd., and the Automatic Telephone & Electric Co., Ltd., for a multi-channel radio telecommunications system linking the towns of Luanda, Malange and Marechal Carmona, in Angola, Portuguese West Africa. The order has been placed by the Angolian postal and telegraph authorities through the companies' associates, Automática Eléctrica Portuguesa (S.A.R.L.). This will be the first multi-channel radio system in Angola, and is the first step in the construction of a much larger one. The total distance covered by the system will be approximately 600 km, built in three sections.

1,000,000 "Ekcovision" Receivers

On 11th December the 1,000,000th "Ekcovision" television receiver came off the production line at the Southend-on-Sea works of E. K. Cole, Ltd. The set—a 17in table receiver with v.h.f. radio (model T311)—was presented by Mr. E. K. Cole, chairman and managing director, to Nurse E. M. Howling, who accepted it on behalf of a local children's home. The presentation ceremony, which took place in the works, was attended by the Mayor of Southend (Councillor F. J. Woods, J.P.), directors, senior executives and works employees.

Vehicle Speed Measurement

An electronic vehicle speed measuring equipment incorporating fifty-four transistors has been developed by Venner Electronics, Ltd., and is being tested by the Metropolitan Police on outer London roads.

The equipment was primarily developed for the Road Research Laboratories of the D.S.I.R. and is basically a device for measuring small intervals of time to a high degree of accuracy. Attached to the electronic elapsed time indicator are two rubber

Venner vehicle speed measuring equipment

tubes long enough to span the road, each of which is connected to a pressure switch. The tubes are laid across the road at right angles to the traffic flow and spaced 70·4in apart.

The equipment incorporates a crystal oscillator operating at 10 kc/s as the basic time element. The output of this unit is passed to two binary dividers to give a 2·5 kc/s signal which is in turn fed to a gating circuit. The gate is opened by the passing of a vehicle over the first strip and closed by the vehicle passing over the second strip. The pulses passing through the gate while it is open are counted by three decade counting stages with digital presentation on meters calibrated from 0 to 9.

If the first meter indicates 3, the second 4 and the third 5, then this is the interval of time in 0·4 millisec steps which elapsed while the vehicle traversed the measured distance of 70·4in. The frequency and distance are chosen so that the resultant indication may be divided into 10,000 giving the speed of the vehicle. Thus, in the case given the speed corresponds to 29 m.p.h. The accuracy is ± 1 count for any figure recorded and thus at 30 m.p.h. (indication 333) the accuracy is about $\pm \frac{1}{2}$ per cent. At 100 m.p.h. (indication 100) the accuracy is to within ± 1 per cent. The equipment is portable, batteries being included in the case which measures 13in by 9in by 7in.

London Television Power Increased

On 18th December the effective power of the Crystal Palace, London, television station of the British Broadcasting Corporation was increased to 200 kW. This increase in the signal strength by about 40 per cent will benefit the 15 million people within the range of the station, particularly those who live in the fringe areas.

The completion of the permanent aerial has been delayed until now because the design of the 710ft tower had to be modified when the B.B.C. agreed to make provision on it for the television aerials for the Independent Television Authority.

The permanent aerial consists of eight tiers of dipoles extending from a height of 350ft to 505ft on the self-supporting tower. The aerial is divided into two groups, four upper and four lower tiers. Each group is supplied by a separate feeder which brings into full operation the safeguards against breakdown already incorporated in the design and layout of the station's equipment. Each of the two pairs of vision and sound transmitters will normally be connected to one half of the completed aerial. The connections from the transmitters to the aerial feeders are made through a comprehensive switching arrangement, so that either pair of transmitters can be connected to either half of the aerial, or alternatively, either pair of transmitters can be connected to the complete aerial.

"Atlas" Mercury Lamps

Extensive life tests carried out on the range of "Atlas" mercury discharge lamps show that an average effective life of 5,000 hours is now being achieved with the MA/V, MB/U and MVF/U types. This increase in life has been achieved without affecting the lumen efficiency data already published for a life of 4,000 hours. Prices of all mercury discharge lamps remain unchanged.

Advertisement Correction

The Midland Coil Winding Co., Ltd., state that in their advertisement in our issue of 6th December the price of their twin tube ballast was inadvertently given as £4 10s "net," instead of "list."

Calendars and Diaries

The neat calendar of Stewarts & Lloyds, Ltd., can be either hung or used as a desk calendar; it has monthly slips.

The pocket diary of Aerialite, Ltd., has a number of pages of technical data relating to radio and television, and there are a number of plates illustrating causes of television interference. The diary is neatly bound in green limp leatherette.

The diary of Marconi Instruments, Ltd., has a navy blue soft leather binding and in addition to the usual diary information contains a number of pages of useful technical data.

The useful calendar of Panelec (Great Britain), Ltd., in addition to the monthly tear-off slips, has also slips showing the preceding and following months and also three years at a glance. It is mounted on a strong board and draws attention to the "Panelec" floor warming systems.

The Brush Group has sent us a calendar with large monthly sheets each of which has a picture in colour of the changing seasons and the British countryside.

Change of Name

The Board of Trade is being asked to sanction the change of name of the Parkinson Stove Co., Ltd., on 1st January to Parkinson Cowan Appliances, Ltd.

Trade Announcements

Fisher & Ludlow, Ltd., are opening, on 1st January next, a new Scottish office at Fisholow House, Fife Crescent, Bothwell, Glasgow. Mr. F. P. Whiteley will be in charge of the new office.

Ekco-Ensign Electric, Ltd., has appointed Mr. E. T. Radford to its illuminating engineering division, and he will be operating from the Glasgow depot. Mr. Radford was previously with the General Electric Co., Ltd., for twenty-three years. Mr. H. L. Lloyd has also recently joined Ekco-Ensign as its representative covering part of the South-West London area and the W.C.2 district.

Stanley Works (G.B.), Ltd., Rutland Road, Sheffield, 3, manufacturers of hand tools, have now extended their Service Department and have taken over responsibility for servicing Stanley electric tools made in the United States.

Transformers (Watford), Ltd., announce that they are now distributors of the "Phorpres" earthenware cable covers to B.S. 2484 : 1956, manufactured by the parent company, the London Brick Co., Ltd. All inquiries in this connection should be addressed to Transformers (Watford), Ltd., Sandown Road, Watford, Herts.

To implement the K.G. (Holdings), Ltd., group of companies' policy of integration and expansion, it has been decided to amalgamate the development and production resources of **Bonochord, Ltd.,** and **W.S. Electronics, Ltd.,** within the laboratory and factory of W.S. Electronics at 44, Brunel Road, Acton, London, W.3. The products and services of Bonochord, Ltd., will continue as now, but from the new address; its head office remains at 48, Welbeck Street, London, W.1. All purchases will be made in the name of W.S. Electronics, Ltd., and all orders, whether for Bonochord or W.S. factory supplies, will be issued by W.S. Outstanding orders placed by Bonochord, Ltd., should be delivered to Brunel Road. Mr. B. J. Brown becomes works manager of the new combined unit, and Mr. R. A. Cail the technical manager. The general manager of W.S. Electronics, Ltd., Colonel A. E. Tyler, O.B.E., will be general manager of the new combined unit.

GENERATION AND DEVELOPMENT

Plant Extensions in November

The monthly statement of the Ministry of Power shows that an additional 241 MW of generating plant was commissioned in November. This was the third highest increase so far this year, being exceeded only in June (392 MW) and September (299 MW).

ELECTRICITY GENERATED AND SENT OUT FOR PUBLIC SUPPLY

	Fuel consumed Thousand tons			kWh generated Millions			kWh sent out Millions	Installed capacity (m.c.r.) MW
	Coal	Coke and Breeze	Oil	Steam	Water power	Total		
Central Electricity Authority ...	4,089	70	92·0	8,030	18	8,058	7,571	23,796
North of Scotland H.E.B. ...	15	—	1·4	26	155	187	185	841
South of Scotland E.B.	276	7	0·2	538	29	567	537	1,465
Total for November, 1957 ...	4,380	77	93·6	8,594	202	*8,812	8,293	26,102
Corres. total for November, 1956	4,291	72	28·0	8,105	151	8,271	7,786	23,930
Inc. or dec., per cent	+2·1	+7·4	+234·1	+6·0	+34·4	+6·5	+6·5	+9·1
Total to date (11 months) 1957 ...	40,919	772	474·6	79,537	1,865	81,527	76,607	
Total for corres. 11 months of 1956	40,446	819	356·9	77,171	1,378	78,702	73,953	
Inc. or dec., per cent	+1·2	−5·8	+33·0	+3·1	+35·3	+3·6	+3·6	

* The total figure includes generation by other methods amounting to 16 million kWh.

The total plant installed in power stations of the Central Electricity Authority, the North of Scotland Hydro-Electric Board and the South of Scotland Electricity Board at the end of the month was 26,102 MW, an increase of 1,487 MW since the beginning of the year.

Four new sets and four boilers were installed in C.E.A. stations last month. The sets were commissioned at Tilbury "A" (60 MW English Electric), Brighton "B" (60 MW Richardsons Westgarth), Castle Donington (100 MW Metropolitan-Vickers) and Lincoln (20 MW Brush Electrical Engineering Co.) and the boilers at Ferrybridge "B" (100 MW equivalent Babcock & Wilcox), Hams Hall "C" (60 MW Simon-Carves), Meaford "B" (60 MW Babcock & Wilcox) and Hackney "B" (30 MW Simon-Carves).

Output rose by 6·5 per cent in November as compared with the previous month's rate of 5·6 per cent; the average for the eleven months of the year was 3·6 per cent (see table).

Besides public supply, 9,423 million kWh has been generated by industry since the beginning of the year (to 23rd November), an increase of 7·3 per cent over the total for the corresponding period of 1956.

Scottish Inquiry

The North of Scotland Hydro-Electric Board's £14,250,000 Strathfarrar and Kilmorack project was the subject of a public inquiry which opened in Parliament House, Edinburgh, on 9th December. It is proposed, under the scheme, to harness the waters of the rivers Farrar and Beauly for use in four power stations which will produce 261 million kWh annually.

The two principal objectors were Major Sir Robert Spencer-Nairn, Bt., owner of the Struy Estate at the junction of Strathfarrar and Strathglass, and Mr. John Mackay, Patt, Struy, Inverness-shire. Major Sir Robert Spencer-Nairn claimed that the scheme would do "irreparable damage" to the salmon fishing. Mr. John Mackay objected on the ground of the effect on land and homes of the raising of Loch Monar.

The Commissioner presiding over the inquiry was Mr. R. S. Johnston, Q.C., appointed by the Secretary of State for Scotland. Appearing for the North of Scotland Hydro-Electric Board were Mr. C. J. D. Shaw, Q.C., Dean of the Faculty, and Mr. N. Thomson, advocate. The two main objectors were represented by Mr. W. I. R. Fraser, Q.C., and Mr. C. E. Jauncey, advocate.

Presenting the case for the Board, Mr. Shaw stressed the necessity in the public interest of developing Scottish hydro-electric power. He submitted that there was a preponderance of public opinion in favour of the scheme. The present demand in the Board's area was 457,000 kW and it was estimated that in 1961-62, when the scheme would come into operation, the demand would be 632,000 kW; that increase could not be met without the present scheme. As far as fisheries were concerned, Mr. Shaw said that the capital work the Board had allowed for protection would cost £375,000. The scheme would have a beneficial and not a detrimental effect on fishing, because the compensation water would take away disastrous droughts and floods.

Mr. Thomas Johnston, chairman of the Board, pointed out that the scheme would result in the saving of 145,000 tons of coal a year which would otherwise have to be imported. The cost of producing electricity by means of the project, after allowing for contingencies, would be 0·87d/kWh.

The Commissioner, at the conclusion of the hearing, announced that he would visit the site on 3rd January with representatives of the promoters and the objectors.

Transport Modernisation

Bradford Transport Committee has approved expenditure of £150,000 for each of three years on a modified scheme of vehicle replacement to be prepared by the general manager in consultation with the city treasurer. The vehicles required will consist of trolley-buses and motor-buses.

OVERSEAS

Formation of Zanzibar Electricity Board

The electricity supply undertaking in Zanzibar, which has been operated for many years by the Public Works Department, is to be taken over by an Electricity Board as from 1st January. The manager to the new Board is Mr. J. M. Paul, D.F.H., A.M.I.E.E., who in February last was appointed as chief engineer and manager of the electricity undertaking. Mr. Paul was with the Uganda Electricity Board for seven years and before that with the Central Electricity Board and the British Electricity Authority in the United Kingdom.

The Zanzibar electricity undertaking is probably the oldest in East and Central Africa. Public supply was commenced there by an American company in 1907, but previously, in 1886, a generator had been installed to supply the Sultan's palaces with electricity for forty 2,000 c.p. arc lamps.

Electricity supplies continued on d.c. until the end of 1954 when a new a.c. scheme was introduced. Since then there has been a rapid increase in demand, which this year has been about 25 per cent above the 1956 level.

One of the first projects which will exercise the new Board is the provision of a supply of electricity to the island of Pemba.

Progress of Dominican Republic Electrification

Continuing its programme for complete national electrification, the Dominican Republic Electricity Corporation has just completed a further stage by starting transmission to a large southern area around the towns of Sabana Grande de Palenque and Juan Baron. Under the ten-year plan generating plant capacity will be raised from 61,500 to 159,000 kW. A nuclear power station has been ordered from the United States.

Financial Section

STOCKS and SHARES

THE year now ending will be remembered mainly, in the Stock Exchange, for the dramatic change of scene produced in mid-September by the hoisting of the Bank Rate to 7 per cent, with the other measures taken in defence of the pound and in general opposition to the forces of inflation. In the subsequent market slump the majority of industrial share prices fell at one time to the lowest points for more than three years. Recovery in the closing stages lifted prices fairly well clear of the bottom, and towards the end of December it appeared that in the final result the average net depreciation in the second half of the year would be only slightly larger than the appreciation recorded in the first six months, when the trend of capital out of gilt-edged into ordinary stocks was still in full swing. As is shown by the following tables of comparison, experiences in the various sections of the electrical equipment and engineering market have varied a good deal, but in the majority of cases the year's fluctuations have been ironed out into a moderate decline in values. The figures have been adjusted for scrip issues made during the year, but not for "rights" issues of shares. An (r) marks the prices affected in that way.

Gilt-Edged Stocks

Declines of 4 to 6 points in the prices of the five principal British Electricity stocks measure the extent of the net depreciation in Government and other gilt-edged securities over the past twelve months. In view of recent happenings, it comes as something of a surprise to recall that in February of this year there was a reduction in the Bank Rate, from 5½ to 5 per cent. That event gave the gilt-edged market a good start, but mounting anxiety over the rising pressure of inflation subsequently kept moving a steady emigration of capital out of fixed-interest stocks of all kinds. September's Bank Rate decision produced automatically a further drop in prices, but its anti-inflationary purpose has since been appreciated to the extent that in the last quarter the firmness of gilt-edged stocks has contrasted strongly with the weakness of ordinary shares.

Nuclear Power Groups

In the early part of the year the unfolding of plans for nuclear power plant construction, and the organising of the consortiums of electrical and engineering companies principally concerned, brought into high favour the shares connected with these developments. Later came appreciation of the long-term character of the potentialities in this field, and evidence in some company reports that meanwhile the contraction of profit margins through increases in wages and other costs was affecting current earnings. Much of the gain in prices was lost, and several shares were left with fairly substantial depreciation on balance. English Electric and Clarke Chapman moderately raised their dividends. With Crompton Parkinson and C. A. Parsons they are among the shares to approach the end of the year at prices higher than those at the beginning:—

Company	Price 1957		Change
	Jan.	Dec.	
A.E.I.	66/3	48/–	–18/3
J. Thompson	29/9(r)	25/6	– 4/3
G.E.C....	50/–	38/6	–11/6
Simon-Carves ...	26/9	25/–	– 1/9
English Electric ...	48/9(r)	49/3	+ 6d
Babcock & Wilcox ...	73/9	58/6	–15/3
C. A. Parsons... ...	52/6	53/–	+ 6d
A. Reyrolle	91/3	80/–	–11/3
Head Wrightson ...	19/3	19/–	– 3d
Clarke Chapman ...	127/6	133/6	+ 6/–
Crompton Parkinson	13/9	15/3	+ 1/6
Richardsons Westgarth	17/3	14/9	– 2/6
Intl. Combustion ...	20/–	21/–	+ 1/–

Electrical Equipment

In the general fields of electrical equipment and manufacturing the fall of prices in the later part of the year roughly cancelled out the big advances in the earlier months, but the final result left a reasonably satisfactory comparison between quotations at the beginning and the end of the year. Of the companies in the following group, four were able to pay larger dividends and there was one reduction:—

Company	Price 1957		Change
	Jan.	Dec.	
Brook Motors ...	30/–	33/3	+ 3/3
Crabtree Elec. ...	23/–	24/–	+ 1/–
Desoutter	14/6	15/3	+ 9d
Dewhurst	5/9	7/9	+ 2/–
Elec. Construction ...	22/6	23/3	+ 9d
Hackbridge & Hewittic	13/9	11/6	– 2/3
Lancashire Dynamo ...	37/6	33/3	– 4/3
Laurence Scott ...	13/9(r)	14/6	+ 9d
Switchgear & Cowans	13/–	9/6	– 3/6
Ward & Goldstone ...	18/9	24/–	+ 5/3
A. West	9/3	10/–	+ 9d
Westinghouse ...	34/6(r)	32/–	– 2/6

Cables and Telephones

In addition to the more general factors affecting the industrial market, shares of the cable manufacturing companies have been up against the prospect that this year's results will again have been affected by stock losses arising from the continued slump in the price of copper. With some exceptions, prices in this group suffered consequently rather more than the average. Telephone company shares have mostly done better, assisted by a growing interest in the future of electronic exchanges:—

Company	Price 1957		Change
	Jan.	Dec.	
Aberdare	10/3	10/6	+ 3d
Automatic Tel. ...	52/6(r)	57/9	+ 5/3
B.I.C.C.	50/3	40/–	–10/3
Dictograph	5/6	5/9	+ 3d
Enfield...	14/–	12/9	– 1/3
Ericsson	17/3	19/–	+ 1/9
Hackbridge Hldgs. ...	20/3	11/9	– 8/6
Henley's	15/3	11/6	– 3/9
J. & P.	28/9	18/6	–10/3
L.E.W.	42/6	41/3	– 1/3
T.C. & M.	24/6	24/–	– 6d
Telephone Mfg. ...	6/6	5/6	– 1/–

Radios and Others

In the field of radio, television and electronics there have been big movements during the course of the year, which is ending with prices generally not greatly different from those ruling twelve months previously. Shares connected with domestic appliances did well on the strength of reports of substantially better business. The revival of activity in the motor-car industry helped similarly the shares of firms engaged in the manufacture of vehicle electrical equipment and accessories:—

Company	Price 1957		Change
	Jan.	Dec.	
Chloride Elec. ...	57/6	58/–	+ 6d
Cole, E. K.	16/6	17/6	+ 1/–
Cossor	6/–	5/3	– 9d
Decca "A"	28/9(r)	26/9	– 2/–
E.M.I.	24/–	27/6	+ 3/6
Ever Ready	14/3	14/–	– 3d
Hoover	24/6	33/–	+ 8/6
Lucas	30/9	28/–	– 2/9
Morphy-Richards ...	12/–	14/6	+ 2/6
Plessey	61/–	60/–	– 1/–
Pye "A"	16/3	13/–	– 3/3
Smith, S.	6/6	7/3	+ 9d
Thorn Elec.	16/–	21/3	+ 5/3

Loan and Debenture Stocks

As a corollary to the recent hardening of confidence in gilt-edged stocks, there has been a notable change for the better in the investor's attitude towards company debenture, loan and preference stocks. In recogniion of this, an increasingly large number of companies has been meeting new capital requirements by offers of stock carrying a fixed and attractive rate of interest, accompanied in some cases with an option of future conversion into ordinary shares. The electrical markets can now offer a range of fixed-interest stocks from which the investor can see returns of around 6 per cent, with first rate security, on his capital. Examples are the 6 per cent unsecured loan stocks of G.E.C. and Vickers, both available at a little under par, and the English Electric 5½ per cent debenture quoted at 94.

On account of the Christmas holiday we are unable to publish our share list. It will appear as usual in next week's issue

REPORTS and DIVIDENDS

Contactor Switchgear, Ltd.—The annual meeting was held on 16th December, Mr. H. Rayner (chairman and joint managing director) presiding. In his circulated statement, the chairman said that they proposed placing a further £55,000 to reserve, as the increase in business necessitated further building and plant. The company was twenty-one years old this year.

Orders in hand were even greater than at this time last year, and the trading results up to the present for this financial year were satisfactory, in spite of increasing competition. Plans for a building at Leominster were well advanced and it was hoped that this building would be completed within a year. Mr. Rayner announced that he was giving up his position as joint managing director in the New Year, but would remain chairman. Mr. A. V. Lawry was being asked to become a joint managing director in his place.

The Heenan Group, Ltd., held its annual meeting on 16th December. In the course of his circulated statement, Mr. C. L. Hill (chairman) said that the total orders received by the group during the year were higher than in the previous year, but the balance at the year end was some £450,000 lower at £5 million, due entirely to an increase in deliveries. Dealing with the activities of the various subsidiaries, Mr. Hill said that the electronic engineering section of Heenan & Froude, Ltd., was closely linked with other sections of the business in designing and developing control gear for various specialities and, with the demand for new control techniques, the electronic equipment delivered in the year represented a 75 per cent increase on the previous year. The industrial cooler section recorded a marked increase in orders, including nearly 200 air and oil coolers for a hydro-electric plant in the United States. Sales of the Heenan-Marley cooling towers were well up on last year; during the year, double-flow cooling towers were added to the Heenan-Marley range. W. G. Bagnall, Ltd., was building diesel-electric locomotives for British Railways and for industrial users.

Aerialite, Ltd.—Mr. L. S. Hargreaves (chairman and managing director) presided at the annual meeting held on 19th December. In his circulated review of the past year he said that sales had kept up satisfactorily and expansion was still proceeding. They had again executed orders for most of the Government and Service Departments and had supplied their products to a wide range of industries. The whole of the wiring for the new independent television station for T.W.W., Ltd., at Cardiff, had been supplied by them and they had also supplied the whole of the cable, including armoured cable, for the largest coal washing plant in Europe, at Manvers Main Colliery. Television and radio sales had kept up well. In spite of keen competition in the cable business they had maintained their turnover and profit. They had increased their export trade during the year. In the first six months of the current year sales and profits were higher and the trend continued.

The British Electric Resistance Co., Ltd.—The annual meeting was held on 16th December, Mr. H. Paul-Huhne (chairman and managing director) presiding. In his circulated statement, the chairman said that there had been a substantial increase during the year in sales arising not from any increase in selling prices, but as a result of their being able to give better deliveries. The results of the English subsidiary, the British Power Transformer Co., Ltd., were again satisfactory.

Direct exports were now running at over 15 per cent of the total sales, but as the bulk of their production was supplied to the largest electrical manufacturers in this country it was not possible to ascertain exactly what proportion of their total turnover was ultimately exported, but they estimated it to be in the region of 60 per cent.

The year under review had been one of intensive research and on the technical side interesting progress had been made in the development of new lines, the influence of which would be felt more fully as time went on.

R. A. Lister & Co., Ltd., report consolidated profits for the year to 30th September last of £1,098,638, as compared with £1,049,313 for the preceding year, but after a heavier taxation charge of £623,097 (against £566,586), the net profit is less than last year at £475,541 (£482,727). Of the net balance £35,048 is retained by subsidiaries, leaving £440,493 to be dealt with in the accounts of the parent company. The dividend for the year is maintained at 10 per cent by a final payment of 7½ per cent.

Pinchin, Johnson & Associates, Ltd., have announced an interim dividend of 5 per cent (unchanged).

Renold Chains, Ltd., are paying an interim dividend of 3 per cent (unchanged).

Murex, Ltd., has declared an interim dividend of 7½ per cent (unchanged).

Radio Rentals, Ltd., reports a group profit for the year ended 31st August last of £1,322,900, as compared with £1,028,586 in the preceding year. Taxation absorbs £717,181 and the net profit is £605,719 (against £570,163). It is proposed to pay a final dividend of 22½ per cent, making 30 per cent for the year. In 1955-56, following an interim dividend of 10 per cent, the ordinary capital was doubled by a scrip issue on which a final dividend of 17½ per cent was paid.

Hackbridge Holdings, Ltd., has announced an interim dividend of 7½ per cent (against 10 per cent).

New Companies

Bridge Wholesale Electrical Radio Distributors, Ltd.—Registered 28th November. Capital £2,000. Wholesale distributors, merchants and manufacturers of radio and television apparatus, etc. Directors: W. I. Moffat and Mrs. A. M. C. Moffat. Regd. office: 7, Midland Street, Glasgow, C.1.

Belfast Cables, Ltd.—Registered in Belfast on 18th November. Capital £60,000. To manufacture, buy, sell, let on hire, maintain or deal in electric wires, cords, cables, etc. Regd. office: Carnmoney, Belfast.

George Radio (Clapton), Ltd.—Registered 16th December. Capital £1,000. Manufacturers of and dealers in electrical goods of all kinds, etc. Directors: G. S. Tovey and A. J. Beaver. Regd. office: 40, Goodge Street, W.1.

Wholesale Distributors, Ltd.—Registered 16th December. Capital £500. Manufacturers' agents, wholesale factors of and dealers in hardware, electrical appliances, cable, etc. Directors: G. J. Harwood and Ruth B. Harwood. Regd. office: 13, Subway Road, Barry, Glam.

Bankruptcies

A. R. Hunt, carrying on business as Hunt Brothers at 68, Thornaby Road, Thornaby-on-Tees, radio and electrical engineer.—Receiving order made 13th December on debtor's own petition.

W. J. K. Incledon, 38, Primrose Drive, Huyton, Lancs, lately carrying on business at 203, West Derby Road, Liverpool, electrical engineer.—Application for discharge to be heard on 21st January at the Court House, India Buildings, 5th Floor, Water Street, Liverpool, 2.

G. B. Solomon, 57, Fore Street, St. Columb, Cornwall, trading as St. Columb Radio, radio and electrical dealer.—Last day for receiving proofs for dividend 3rd January. Trustee, Mr. J. E. Ellis, 50, The Terrace, Torquay.

D. Beck, formerly carrying on business at 96, Harris Street, Bradford, and lately carrying on business under the name of Electrical & Hardware Appliances, and residing at "Kebroyd," Ings Lane, Guiseley, Yorks, electrical appliances dealer.—First and final dividend of 1s 7½d in the £, payable on and after 31st December at the Official Receiver's office, 3rd Floor, Pearl Chambers, East Parade, Leeds, 1.

Liquidations

Reedy Radio, Ltd., electrical contractors, 40, North-Western Avenue, Watford, Herts.—Winding up voluntarily. Liquidator, Mr. P. J. L. Case, 30, Clarendon Road, Watford, appointed 10th December. Particulars of claims to the liquidator by 31st January.

Electric Utilities, Ltd., electrical and mechanical engineers, Bridge House, Christchurch, Hants.—Winding up voluntarily in accordance with section 278 of the Companies' Act, 1948. Liquidator, Mr. A. S. Holmes, Barclays Bank Chambers, 44, High Street, Southall, Middx, appointed 9th December.

Qwik Electrics, Ltd. (in voluntary liquidation).—Meetings of members and creditors on 14th January at 70, Norman Road, Manchester, 14, to receive an account of the winding-up by the liquidator, Mr. W. J. Seed.

R. Russell (Electrical), Ltd., electrical engineers, 187-189, Upper Richmond Road, London, S.W.15.—First and final dividend of 20s in the £, payable on and after 30th December at the offices of Percy Phillips & Co., 76, New Cavendish Street, London, W.1.

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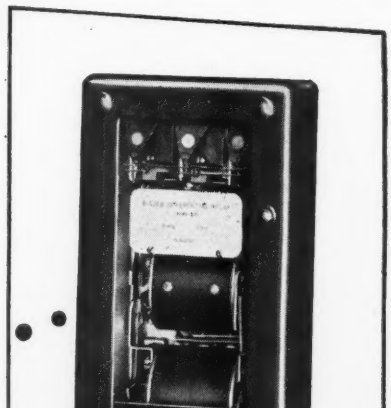

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NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) will be obtainable after 2nd January from the Patent Office, 25, Southampton Buildings, London, W.C.2

1953

10229. Phillips, W. J., and Brookland, G. R.—Carbon electrodes for use in arc lamps. 14th October, 1954. (788600.)

18109. British Thomson-Houston Co., Ltd.—Impregnated electrical components. 30th June, 1954. (788391.)

24260. Standard Telephones & Cables, Ltd.—Cold cathode gas-filled electric discharge tubes. 2nd September, 1953. (Addition to 734345.) (788591.)

24261. Standard Telephones & Cables, Ltd.—Selector switches and automatic telecommunication systems using such selector switches. 27th August, 1954. (788592.)

26184. Electric & Musical Industries, Ltd. —High frequency electrical connections. 13th September, 1954. (788441.)

1954

10833. Isotope Developments, Ltd., and Eppstein, J. S. B.—Automatic voltage stabilisers. 13th April, 1955. (788442.)

16952. Conradty, E. K., Conradty, P., Conradty, M., and Conradty, C.—Anode carbons for high power arc lamps. 9th June, 1954. (788605.)

19080. Telephone Manufacturing Co., Ltd.—Signalling receiver arrangements in carrier-wave multiplex telephone systems. 27th June, 1955. (788606.)

21746. Plessey Co., Ltd.—Electric signal storage devices and apparatus. 11th July, 1955. (788352.)

21747. Plessey Co., Ltd.—Storage devices. 11th July, 1955. (788353.)

22375. Telefonaktiebolaget L. M. Ericsson.—Electron tube devices. 30th July, 1954. (788508.)

24996. Griffin, A. A.—Apparatus for reproducing sound from audio-frequency electrical signals. 25th October, 1955. (788543.)

25190. Siemens-Schuckertwerke Akt.-Ges.—Means for controlling the frequency, the load distribution and the synchronous clock time in an electric power grid. 30th August, 1954. (788395.)

27258. National Research Development Corporation.—Electro-forming. 12th December, 1955. (788545.)

35900. Licentia Patent-Verwaltungs-Ges. —Testing arrangement for electric circuit-breakers. 10th December, 1954. (788548.)

37768. Pritchett & Gold & E.P.S. Co., Ltd.—Electric storage battery carriers. 9th December, 1955. (788448.)

1955

4065. Thorn Electrical Industries, Ltd.— Method of improving the luminescence of luminescent materials and luminescent materials when improved by the method. 10th February, 1955. (788451.)

4089. Automatic Telephone & Electric Co., Ltd.—Electrical impulse receiving circuits. 7th February, 1956. (788552.)

4473/4/5. Standard Telephones & Cables, Ltd.—Automatic telecommunication exchange systems. 27th August, 1954. (Divided out of 788592.) (788593/4/5.)

9455. Carter, A. C., and Plowman, J. M. —Electromagnetic vibrators. 29th March, 1956. (788514.)

10086. Philips Electrical Industries, Ltd. —Circuit arrangements for producing flashes of light. 6th April, 1955. (788403.)

12999. Electricité de France.—Voltage detecting apparatus. 4th May, 1955. (788458.)

13358. Elox Corporation of Michigan.— Electric arc machining apparatus. 9th May, 1955. (788366.)

14505. Soc. Anon. Française du Ferodo. —Electro-centrifugal clutches. 19th May, 1955. (788367.)

14635. Lucas (Industries), Ltd., J.— Means for protecting an electric motor against overloads. 19th April, 1956. (788612.)

15304. McDonald Furnaces, Ltd.—Electric furnaces. 22nd May, 1956. (788461.)

18721. British Dielectric Research, Ltd. —Variable capacitors. 27th June, 1956. (788614.)

19267. Askania-Werke Akt.-Ges.—Devices for measuring small d.c. voltages. 4th July, 1955. (788466.)

19822. Standard Telephones & Cables, Ltd.—Thermoconductive screening can for electronic tube. 8th July, 1955. (788562.)

20256. Revo Electric Co., Ltd.—Electric cookers. 3rd July, 1956. (788616.)

20284. English Electric Valve Co., Ltd.— Gas-filled discharge tubes. 15th May, 1956. (788564.)

20872. Western Electric Co., Inc.—Crossbar switches. 19th July, 1955. (788617.)

21878. Siemens & Halske Akt.-Ges.— Actuating device for alternately opening and closing electric switch contacts. 28th July, 1955. (788371.)

22812. General Electric Co.—Laminated electrical insulation. 8th August, 1955. (788520.)

23082. General Electric Co.—Frequency response determining apparatus. 10th August, 1955. (788565.)

24446. Clarostat Mfg. Co., Inc.—Coupling for electrical controls such as switches, thermostats, potentiometers and the like. 25th August, 1955. (788372.)

28798. Licentia Patent-Verwaltungs-Ges. —Electrically driven drainage pump installation for floating docks. 10th October, 1955. (788414.)

30130. Westinghouse Electric International Co.—Electroluminescent cells. 21st October, 1955. (788479.)

31471. Tugen, R. G.—Combined electrical radiators and convection heaters. 3rd November, 1955. (788623.)

34567. Standard Telephones & Cables, Ltd.—Colour television receiver. 2nd December, 1955. (788576.)

34568. Standard Telephones & Cables, Ltd.—Travelling wave electron discharge devices. 2nd December, 1955. (Addition to 776923.) (788625.)

36506. Humes, Ltd.—Electric arc welding. 20th December, 1955. (788534.)

36726. General Electric Co.—Electrical sockets. 22nd December, 1955. (788626.)

1956

1020. Hoover, Ltd.—Suction cleaners. 11th January, 1956. (788578.)

1028. Soc. Anon. Française du Ferodo.— Control devices for electromagnetic clutches for motor vehicles. 11th January, 1956. (788483.)

5302. Hazeltine Corporation.—Antenna system. 21st February, 1956. (788582.)

5828. General Electric Co., Ltd., Arbon, R. S., and Phylip-Jones, G.—Bi-stable electric apparatus. 24th February, 1956. (788583.)

8265. Pastoor, B. J.—Electric radiators. 16th March, 1956. (788634.)

11554. Barmer Maschinenfabrik Akt.-Ges. —Electrically driven spinning, twisting and winding machines. 16th April, 1956. (Addition to 770710.) (788640.)

11790. Western Electric Co., Inc.— Apparatus for providing identification markings on insulated electrical wires. 18th April, 1956. (788429.)

12837. Compagnie pour la Fabrication des Compteurs et Matériel d'Usines à Gaz.— Device for damping the oscillation elements of electromechanical apparatus. 26th April, 1956. (788432.)

21247. Perk, A. Van Der.—Resistors for large currents. 9th July, 1956. (788386.)

29760. Siemens-Schuckertwerke Akt.-Ges.—Apparatus for producing periodic m.m.f. impulses. 28th September, 1956. (Addition to 745173.) (788438.)

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 4th January:—

CREDA. No. 768,405. Class 7. Machines for washing, drying and ironing, all for laundering purposes; dish washing machines; and machines for the mixing and preparation of foodstuffs.—Simplex Electric Co., Ltd., Broadwell, Oldbury, Birmingham.

VARILECTRIC. No. 768,539. Class 7. Electric starting devices for engines and for motors (not for land vehicles), and parts.—Varilectric, Ltd., 10, Melon Road, Peckham, London, S.E.15.

SABRE ARC. No. 768,557. Class 7. Electrically operated and gas operated machines and apparatus, all for use in arc welding, cutting, brazing and the like heat treatment of metals, and parts. SABRE ARC. No. 768,558. Class 9. Electrodes for electric arc welding, and electric arc welding apparatus (not being machines), and parts.—British Oxygen Gases, Ltd., Bridgewater House, Cleveland Row, St. James's, London, S.W.1.

NEWDAY (design). No. B764,164. Class 9. Electrical apparatus and instruments, but not including cinematograph or sound recording apparatus or any goods of the same description. NEWDAY (design). No. B764,165. Class 11. Apparatus for heating, lighting, cooking, drying and ventilating.—New Day Electric (Sales), Ltd., 28, Queen Anne's Gate, Westminster, London, S.W.1.

REECOMETAL. No. 755,734. Class 9. Fitted cases for electrical instruments; and chassis (mountings) for electronic instruments; all made of common metal.—R. E. Owen, trading as Reosound Engineering & Electrical Co., Reosound Works, Coleshill Road, Sutton Coldfield, Warwickshire.

ACCUREX. No. 767,284. Class 9. Automatic voltage regulators, and electric excitation apparatus (not being machines).—General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.

EDGEMET. No. 768,958. BARMET. No. 768,959. Class 9. Electrical resistors, and parts.—Expanded Metal Co., Ltd., Burwood House, Caxton Street, Westminster, London, S.W.1.

LADDEX. No. 768,530. Class 11. Electric discharge tubes for lighting purposes; and parts and fittings for lighting installations.— Laddex Trading Co., Ltd., Triumph House, 189, Regent Street, London, W.1.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Australia.—Victorian Railways, Melbourne. 22nd January. Lightning arrestors. (E.S.B. 30278/57. Ten/29848.)*

State Electricity Commission of Queensland. 19th February. Protection relays. (E.S.B. 30251/57. Ten/29905.)*

Southern Electric Authority of Queensland, Brisbane. 21st February. Two 11 kV outdoor type circuit-breakers. (E.S.B. 30406/57. Ten/29888.)*

Canada.—Manitoba Hydro-Electric Board, Winnipeg. 8th January. Main control switchboards for Selkirk generating station. (E.S.B. 29728/57. Ten/29885.)*

Chatham.—Corporation. 20th January. Trunk road lighting equipment. (See this issue.)

Dagenham. — Borough Council. 11th January. Electric lamps for one year from 1st April next. Borough engineer and surveyor, Civic Centre.

Derby.—Corporation. 13th January. Trunk road lighting equipment. (See this issue.)

India.—Hindustan Steel Private, Ltd., Rourkela. 17th January. L.v. distribution boards. (E.S.B. 30382/57. Ten/29864.)*

Madras State Electricity Board. 16th January. Six 2,000 kVA and six 3,000 kVA, 33/11 kV power transformers. (E.S.B. 30453/57. Ten/29897.)*

Iran.—Ministry of Posts, Telegraphs and Telephones. 20th January. Medium wave transmitters and accessories. (E.S.B. 30288/57. Ten/29880.)*

Iraq.—Ministry of Development. 3rd March. Cabling (up to 33 kV), lighting and accessories for Basrah power station. (E.S.B. 29784/57. Ten/29813.)*

Central Foreign Purchasing Board, Baghdad. 1st February. Radio telephone service equipment. (E.S.B. 30399/57. Ten/29877.)*

New Zealand.—Cook Hospital Board, Gisborne. 10th January. 125 kW diesel generating set. (E.S.B. 30250/57. Ten/29894.)*

Dunedin Electricity Department. 17th January. Supply of 200 current transformers. (E.S.B. 30434/57. Ten/29893.)*

G.P.O., Wellington. 4th February. Earth rods. (E.S.B. 29664/57. Ten/29777.)*

State Hydro-Electric Department, Wellington. 1st April. Four 33,333 kVA transformer units. (E.S.B. 30361/57. Ten/29875.)*

Pakistan.—Posts and Telegraphs Department, Karachi. 8th January. Underground cables. (E.S.B. 30372/57. Ten/29863.)* 15th January. Galvanometers. (E.S.B. 30425/57. Ten/29874.)* 18th January. Sounders and plugs for Wheatstone bridge. (E.S.B. 30427/57. Ten/29903.)*

Rhodesia and Nyasaland.—Bulawayo Electricity Department. 15th January. Overhead line and service materials. (E.S.B. 30256/57. Ten/29849.)*

Salvador.—Instituto de Vivienda Urbana, San Salvador. 3rd January. Electric lamps for the Faculty of Odontology. (E.S.B. 30501/57. Ten/29910.)*

South Africa.—Union Tender and Supplies Board, Pretoria. 9th January. Electric lighting fittings. (E.S.B. 30269/57. Ten/29852.)* 16th January. X-ray apparatus. (E.S.B. 30273/57. Ten/29830.)* Protectors and cross-connection boxes. (E.S.B. 30274/57. Ten/29842.)*

Sutton Coldfield. — Corporation. 8th January. Trunk road lighting equipment. (See this issue.)

United States.—Bureau of Reclamation, Denver. 9th January. One 8,000 kVA transformer for Loveland substation. (E.S.B. 29747/57. Ten/29861.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Cardiff.—Corporation Parks, Baths and Cemeteries Committee. Directional signs and external lighting fittings for the Wales Empire Pool (£4,457).—W. H. Stone & Co.

Newcastle-upon-Tyne.—Corporation Education Committee. Electrical installation at the new Kenton Secondary Schools (£13,857).—A. S. Lowrey & Son.

Weymouth.—South West Metropolitan Regional Hospital Board. Recommended. Electrical work at the Weymouth and District Hospital (£1,105).—H. W. Smith & Son.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Alnwick.—Proposed St. Mary's R.C. Secondary School (£74,000); R. Carse & Sons, builders, Amble.

Barking.—Factory extensions; Dicky Bird, Ltd., By-pass Road.

Basingstoke.—First phase of technical college, Basingstoke, county grammar school at Havant and technical college at Eastleigh; county architect, The Castle, Winchester.

Houses (35) and flats (12), South Ham; E. Almond, borough architect.

Bexhill-on-Sea.—Works extensions; Elva Engineering Co., Ltd., London Road.

Billingham (Co. Durham).—Ten police houses for Durham C.C.; county architect, South Street, Durham.

Birmingham.—Nine-storey biology building and new buildings for other departments at Edgbaston (£3,000,000), for University Authorities; Sir Hugh Casson and Neville Conder, architects, 35, Thurloe Place, London, S.W.7.

Burton-on-Trent. — County secondary school, Rolleston; Staffs county architect, County Buildings, Martin Street, Stafford.

Bury.—Grammar/technical school; Bradshaw, Gass & Hope, architects, 19, Silverwell Street, Bolton.

Cardiff.—New engineering department at University College of South Wales and Monmouthshire (£1,000,000); registrar, Cathays Park, Cardiff.

Crewe.—Garage and service depot; Crewe Service Station, 75, Earle Street.

Durham.—Additions to Neville's Cross Training College (£250,000); county architect, South Street, Durham.

Edmonton.—Factory, Claverings industrial estate; David Cash & Co., Ltd., 523, Seven Sisters Road, London, N.15.

Eston (Yorks).—Houses (219) for U.D.C.; N. C. Harrison, surveyor.

Felling (Co. Durham).—Reconstruction of Abbotsford Road depot (2nd stage) for the U.D.C. (£12,000); John Clark & Son, builders, Gregson Terrace, Seaham.

Pithead baths at Heworth Colliery; N.C.B. Architect's Department, 24, The Side, Newcastle-on-Tyne.

Gosforth.—Additions to Gosforth Grammar School for Northumberland E.C. (£10,000); Cawood Wharton & Co., Ltd., contractors, Harrogate.

Heston and Isleworth.—Additional office accommodation at Health Centre, Bath Road, Hounslow; D. Mathieson, town clerk, Town Hall, Hounslow.

Hinckley.—Omnibus station and car park, Lancaster Road; U.D.C. surveyor, Station Road.

Ilford.—Shops and showrooms, Station Approach, Cranbrook Road; Lee & Dickins, architects and surveyors, 15, Great James Street, London, W.C.1.

Leicestershire.—County junior school, Wigston Fields; county architect, Leicester.

Lindsey.—Secondary school at Epworth (£143,000), and additions to Foxhills Secondary School, Scunthorpe (£82,000); A. R. Clark, county architect, County Offices, Newland, Lincoln.

Liskeard.—New laboratories and practical subjects rooms at the grammar school; S. Gregson, architect, Tregolls Road, Truro.

Loughton.—Office block, stores, workshops and garages; Tooley & Foster, architects, Midland Bank Chambers, Buckhurst Hill.

Manchester.—Works extensions; Reed Corrugated Cases, Ltd., Ayres Road, Old Trafford.

Houses at Hazel Grove overspill area (234), Catterick Road, Didsbury (11), Crosby Farm, Charlestown (19), Feredene Road, Withington (6), Darley Avenue, West Didsbury (11); director of housing, Town Hall, 2.

North Riding.—Primary school at Nunthorpe; Morrison & Partners, architects, 103, Belper Road, Derby.

School at Catterick Camp; Johns, Slater & Haward, architects, 32, Foundation Street, Ipswich.

Home for aged and infirm people, Richmond (£64,500) and clinic and welfare centre, Eastfield estate, Scarborough (£12,000); county architect, County Hall, Northallerton.

Northumberland.—Infants' school at Forest Hall; county architect, County Hall, Newcastle-on-Tyne.

Radcliffe.—Works extensions; General Engineering Co. (Radcliffe), Ltd., Bury Road.

Stafford.—Dwellings (166), Tillington Hall estate; borough engineer, Mount Street.

Sunderland.—Four more children's homes; H. C. Bishop, borough architect, Grange House, Stockton Road, Sunderland.

Garage (20 buses), Toward Road, for Durham District Services; A. A. Briggs, architect, 10, Fleet Street, London, E.C.4.

Swaffham.—Church; Rev. G. G. Langley, Presbytery, Station Street.

Swansea.—Chemistry laboratories, University College; Lucas & Pyke, consulting engineers, 47, Victoria Street, London, S.W.1.

Thorne.—Cottage flats (£20,000), Stainforth and 16 slum clearance houses at Hatfield; Council's architect, Thorne, Yorks.

Wallsend.—Factory, Coast Road, for Tudor Food Products, Ltd., 3a, Sandyford Road, Newcastle-on-Tyne.

Houses (60), Wiltshire Gardens; J. H. James, builder, Archer Street, Wallsend.

Factory buildings, Neptune Road, for Thermal Syndicate, Ltd.; Couves & Partners, architects, Carliol House, Newcastle-on-Tyne.

Walthamstow.—Maisonnettes and flats (49), Cecil Road/Chingford Road/Knebworth Avenue site; borough engineer, Town Hall, Forest Road, E.17.

Whiston.—Additional classrooms, kitchen, hall and dining room at County secondary school; Lancs county architect, County Offices, Preston.

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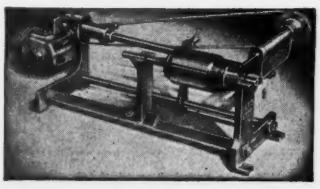

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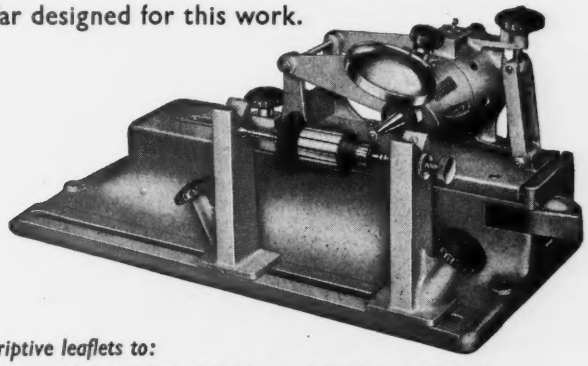

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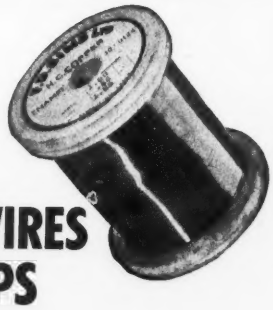

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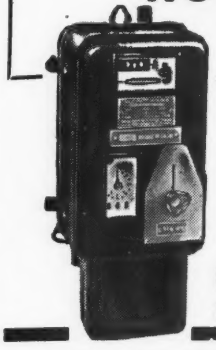

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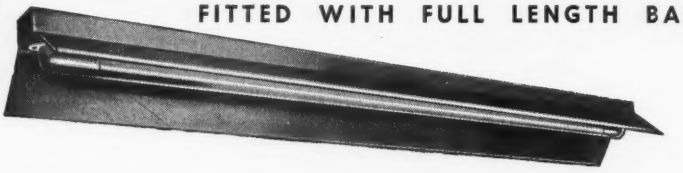

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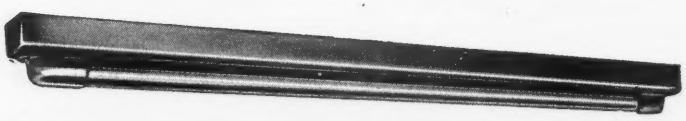

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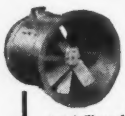

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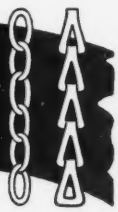

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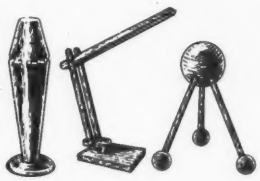

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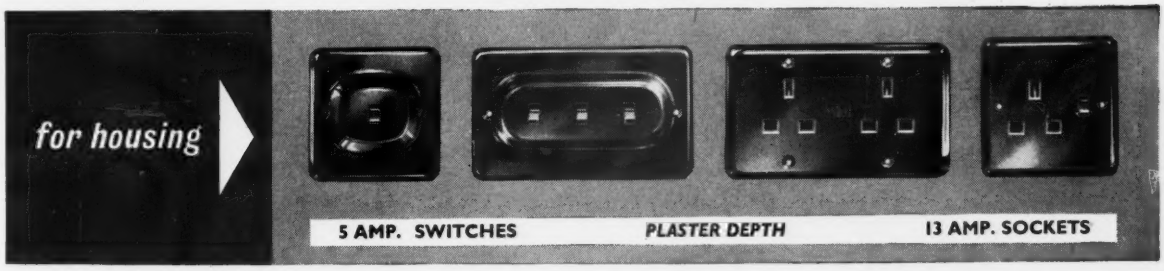

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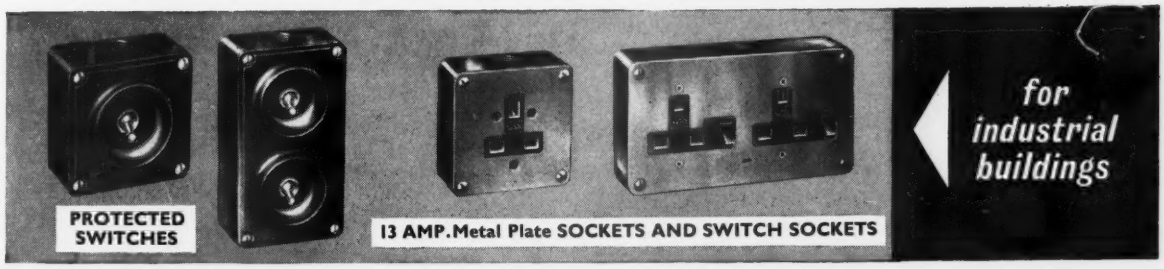

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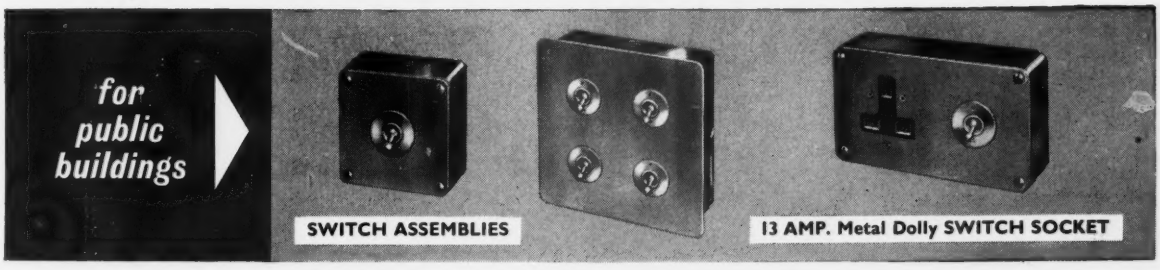

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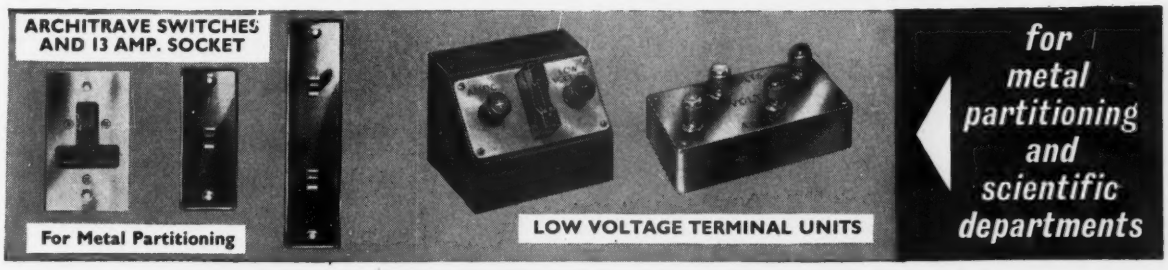
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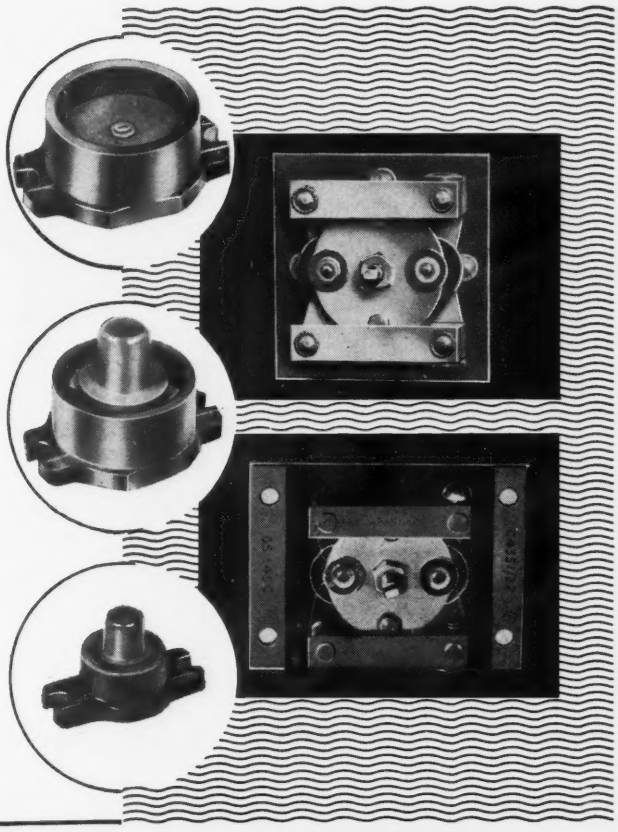

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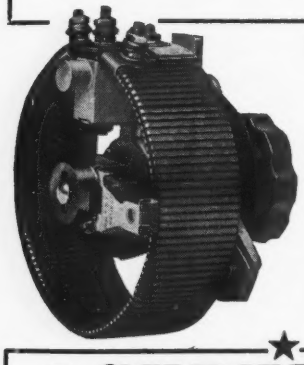

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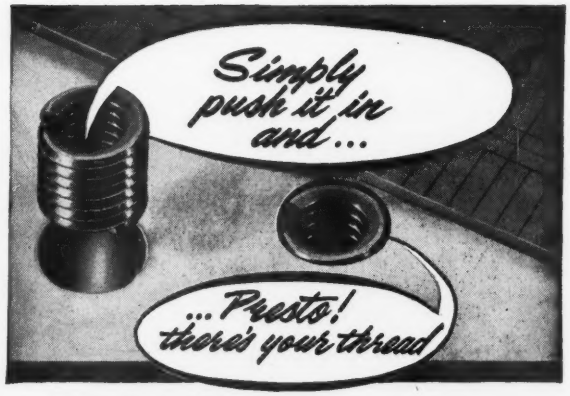


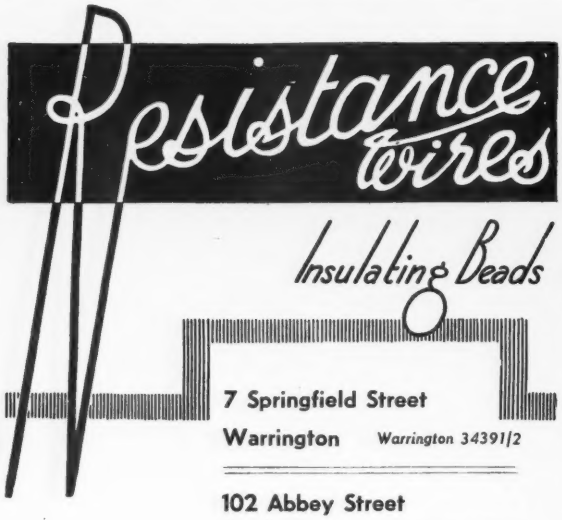
HELI-COIL REGD. TRADE MARK **PUSH-TYPE INSERTS**
THE READY-MADE THREAD FOR MOULDED MATERIALS

Eliminate the need for solid bushing and tapping, use a HELI-COIL PUSH-TYPE INSERT the ready-made screw thread for moulded and plastic parts, die cast alloys, powdered metals, all soft light materials and many hard metals. Pushed directly in drilled cast, or moulded, blind or through holes, this is the ideal low-cost, volume production, fastening method. A few shillings in tooling is all you need for up to 1,200 holes and more per hour.

For faster, cheaper production

Write for details to:
ARMSTRONG PATENTS CO. LTD. BEVERLEY, YORKSHIRE

BAP 8

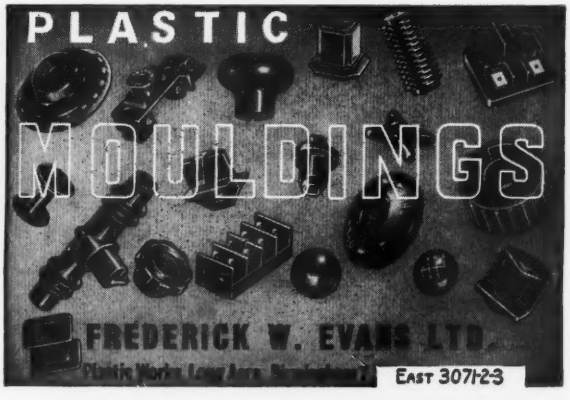


7 Springfield Street
Warrington *Warrington 34391/2*

102 Abbey Street
Accrington *Accrington 2774*

161/163 Eldon Street
Preston *Preston 57975/6*

Lionel Robinson & Co. Ltd.
4 Staple Inn, London, W.C.1
Telephone - - HOLborn 6322



TRANSFORMERS

For Portable Tools
Input 240v or 415v
Output 110v with centre tap earthed

PROMPT DESPATCH
REASONABLE PRICES

THE BANNER ELECTRIC Co. Ltd.
HODDESDON, HERTS *Hodd. 2659*

EXTRA **Equipment Standard** EXTRA

LONDON

27th DECEMBER, 1957

WORKS MANAGERS AND ENGINEERS PROTEST!!

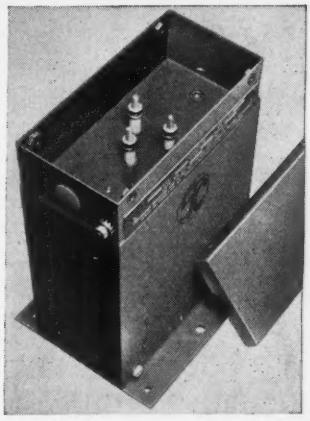
Each claim to have seen S.T.C. Unit Capacitor advertisements first

BUT ALL AGREE THAT NEW UNIT DESIGN JUSTIFIES SERIOUS CONSIDERATION

LATEST

Dispute settled. Both parties amalgamate to press for early installation.

The units are attractive yet inconspicuous. They are contained in an all welded steel case which contains no gaskets likely to cause oil leakage. The adaptability of the system enables the unit to be used for individual motor correction and for larger capacitors of up to 108 kVAr to be assembled from the units. Above all the U.C.S. provides for additions and modifications as the connected load changes with expansion or reorganisation programmes. A few extra parts and a spanner enables one man to increase the size of existing capacitors or to split assemblies into smaller units.

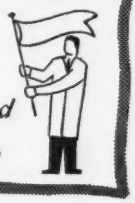


Another success by

Standard Telephones and Cables Limited

Registered Office: Connaught House, Aldwych, London, W.C.2

POWER LINE DIVISION · NORTH WOOLWICH · LONDON, E.16



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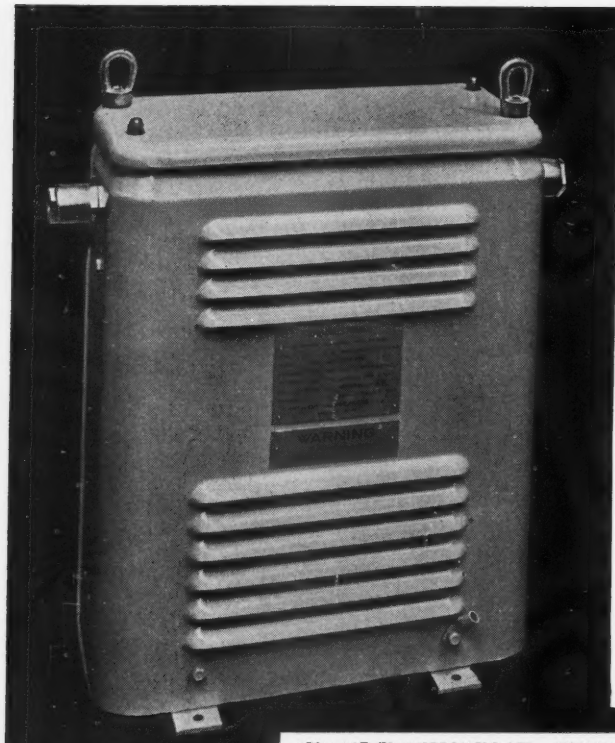


STEWART TRANSFORMERS

TO ADMIRALTY SPECIFICATION 151

Where oil cooling may constitute a fire hazard these transformers may be used with absolute safety.

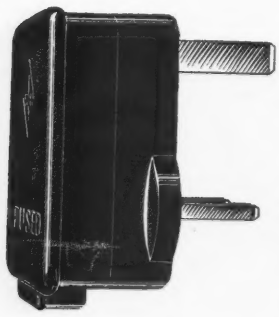
CLASS B

Naturally air cooled.
100% glass insulation.
Temperature rise 75° C.
Saving in weight up to 33⅓%

These transformers have many industrial applications. They may be the solution to your problem

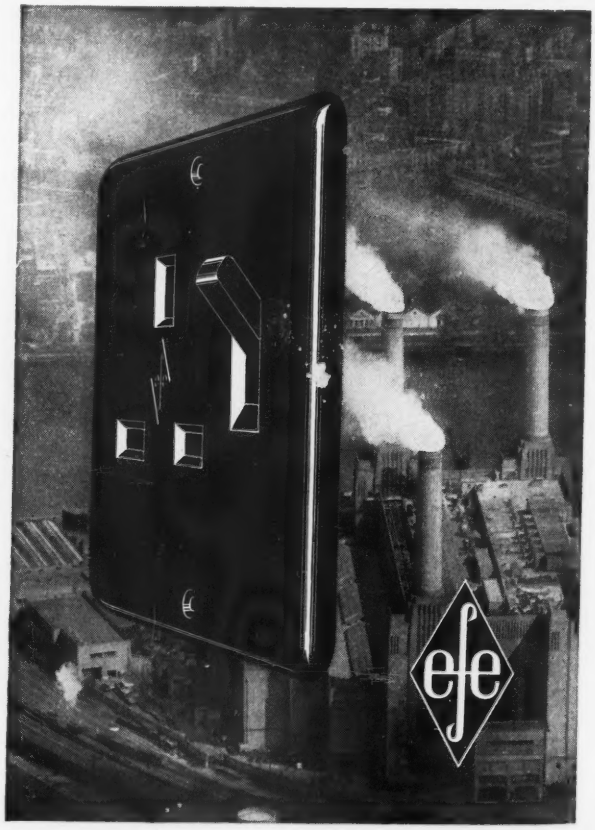
STEWART TRANSFORMERS LTD., KILBURN LANE, LONDON, W.10. TEL.: LADBROKE 2296-7

Plug into power . . .
with E.F.E. accessories



Every E.F.E. product is a powerful ally in your sales drive. Write for details and price lists of the complete range including the new 'RUBY RANGE' now the choice of leading Architects and Designers.

E. F. Electric Limited, Willow Lane, Watford, Herts.
Telephone: WATFORD 6878 • GADEBROOK 2616
Telegrams and Cables: EFE WATFORD



Regional Guide to ELECTRICAL CONTRACTORS

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Electrical Installations
E. R. REDCLIFFE (ELECTRICAL) LTD.
2 Station Road, Chingford, E.4
Telephone : SILverthorn 2356/7

Industrial, Commercial and Housing Installations
Factory Maintenance. Motor Rewinds
EDWARDS, WYATT & COURT (Installations) LTD.
Grant Street, E.13
Telephone: ALBert Dock 5295/6/7

J. G. SNEATH LTD.
Wallwood Street, Limehouse, E.14
Telephone: EAst 2428-9
Rewinds and Repairs. Industrial Installations

Motor and Generator Repairs and Rewinds, Lighting and Power Installations. Factory Maintenance Contracts
COLLINS ELECTRICAL LTD.
115 Clerkenwell Road, E.C.1
Telephone: HOLborn 0212-3-4 & CANonbury 3227-8

Lighting, Heating and Power Installations. Factory Maintenance and Motor Stockists
C. J. FERGUSON & SONS LTD.
33 Barbican, London, E.C.1
Telephone: MONarch 5474-5

Industrial Installations. Power, Heating and Lighting. Factory Maintenance. Electrical Engineers. Break-down Specialists
F. A. ORRICK & CO. LTD.
157 Camberwell Road, S.E.5
Telephone: RODney 5548

BARLOW & YOUNG LTD.
55 Catherine Place, Westminster, S.W.1
Telephone: VICtoria 7373
Installations of all Types

BERKELEY ELECTRICAL ENG. CO. LTD.
Vincent House, Vincent Square, S.W.1
Telephone: VICtoria 8051
Electrical Engineers and Contractors

H. J. CASH & CO. LTD.
Caxton House, Tothill Street, S.W.1
Telephone: WHItehall 4774
Electrical Engineers and Contractors

EDMUNDSONS CONSTRUCTION CO. LTD.
Electrical Engineers and Contractors
24-30 Gillingham Street, S.W.1
Telephone: VICtoria 1713

One of the Largest Electrical Contractors in the Industry
ELECTRICAL INSTALLATIONS LTD.
65 Vincent Square, Westminster, S.W.1
Telephone: VICtoria 2266 (10 lines)

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
39 Victoria Street, S.W.1
Telephone: ABBey 8080 (8 lines)

TROUGHTON & YOUNG LTD.
2 Basil Street, London, S.W.3
Telephone: Kensington 3444
Electrical Engineers and Contractors

BURDETTE & CO. LTD.
150 Clapham Manor Street, S.W.4
Telephone: MACaulay 4555
Industrial Installations. Motor and Generator Repairs. Metallizing Treatments. Complete Electrical Maintenance. Heating and Ventilating.

WILSON ELECTRIC (BATTERSEA) LTD.
122a, Clapham Manor Street, S.W.4
Telephone: MAC 6768 & 3737
Electrical Engineers and Contractors. Motor Rewinds and Repairs. Installations. " Delco " Electric Motors—Approved Stockists and Repairers.

Industrial Installations throughout the Country. Power, Maintenance and Insurance
CITY ELECTRICAL CO.
Emerald Street, W.C.1 *Telephone: HOL. 9722 (6 lines)*
Repairs and Rewinds—Motor Stockists

A. TINDALL & SONS
22 Rosemary Avenue, Enfield
Electrical Engineers and Contractors
Telephone: ENField 6612 (3 lines)

SERVICE ELECTRIC CO. LTD.
Secomak Works, Honeypot Lane, Stanmore, Middx.
Telephone: EDGware 5566-7-8-9
Electrical Installations of every kind. Motor Rewinds. Factory Maintenance

DYNAMO & MOTOR REPAIRS LTD.
North End Road, Wembley Park
Telephone: Wembley 3121
Motor and generator repairs and rewinds. Installations and factory maintenance. Electrical plant stockists

SOUTH EASTERN

GALLIERS
32 St. James's Street, Brighton
Telephone: Brighton 23201-2-3
Farm and Dairy Electrical Equipment

Electrical, Refrigeration and Radio Engineers. Installation Contractors. Lifts. Television
H. BENEY & SONS LTD.
99 South Street, Eastbourne
Telephones 4820/1 (Day and Night)

For first-class A.C. and D.C. Rewinds and Industrial Plant Maintenance
ELECTRICAL POWER REPAIRS (Gillingham) LTD.
Strover Street, Gillingham, Kent
Telephone: Gill. 5200 & 59356 (Day and Night)

Heavy Engineering and Electrical Contracting
DRAKE & FLETCHER LTD.
Maidstone, Kent
Telephone 2284
Refrigeration. Oil Heating and Drying Installations

F. W. BLANSHARD LTD.
23 Lansdowne Road, Purley, Surrey
Telephone: Uplands 4818, 4819 & 4810
Complete electrical installations. Rewinding and repair of motors and transformers. Manufacturers of control gear for fluorescent.

SOUTHERN

. . for all electrical installations
F. H. WHEELER & CO. LTD.
32 Brassey Road, Winton, Bournemouth
Telephone: Winton 1609

. . . for all electrical installations
F. H. WHEELER (Southern) LTD.
Clifton Hall, Oakley Road, Shirley, Southampton
Telephone 73867

SOUTH WESTERN

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F. H. WHEELER (Bristol) LTD.
55 Queen Charlotte Street, Bristol 1
Telephone 26907

CLARKE BROS. (Stroud) LTD.
Bath Road, Stroud
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Electrical Engineers and Contractors
Rewinds and Repairs. Industrial Installations

EASTERN

Norwich.....Cambridge.....Gt. Yarmouth.....Lowestoft.....Ipswich
EASTERN & HOME COUNTIES ELECTRICAL CONTRACTORS
Specialists in Large Scale Electrical Installation Contracts.
Westwood House, Southtown Road, Gt. Yarmouth
Telephone: Gt. Yarm. 2390

EAST MIDLANDS

Electrical Engineers and Contractors
C. A. J. BILLINGTON LTD.
Cranfield, Bedfordshire
Telephone: Cranfield 293
Industrial Installations throughout the Home Counties

PENNEY & PORTER LIMITED
Riverside Works, Lincoln
Telephone: Lincoln 11337
Industrial & Domestic Electrical Installations. Motor & Generator Repairs & Rewinds. Lift & Plant Maintenance. Neon & Illuminated Signs

MIDLANDS

Electrical Industrial Installations. Power, Heating and Lighting. Factory Maintenance. E.C.A. Electrical Engineers
PARKER, WINDER & ACHURCH LTD.
259 Broad Street, Birmingham 1
Telephone: MIDland 5001

(Continued on page 70)

(Continued from page 69)

WALKER BROS. (ELECTRICAL ENGINEERS) LTD.
Quality House, Temple Row, Birmingham 2
Telephone: CEN. 7611/5
Electrical Installation Engineers. Industrial Installation Specialists
Established 1895

HARRIS & SHELDON LTD.
31 Stafford Street, Birmingham 4
Telephone: Central 7101
For all electrical contracting installations, lighting, heating, power, public address, etc.

Electrical and Mechanical Engineers, Factors
THE BIRMINGHAM POWER TRANSMISSIONS LTD.
56-62 Miller Street, Aston, Birmingham 6
Telephone: AST. 2088-9

For Electrical Installations of Quality consult:
HAROLD F. WARD LIMITED
420 Stratford Road, Birmingham 11
Telephone: VIC. 4041 (5 lines)

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
553 Moseley Road, Birmingham 12
Telephone: Calthorpe 2601-2

DYNAMO & MOTOR REPAIRS LTD.
Belgrave Terrace, Soho Road, Birmingham 21
Telephone: Northern 0898
Motor and generator repairs and rewinds. Installations and factory maintenance. Electrical plant stockists

ELECTRICAL INSTALLATIONS LTD.
Faraday Works, Stoney Stanton Road, Coventry
Telephone 2970
Industrial Electrical Work of All Kinds. Over 40 Years' Experience

G. G. WALKER & CO. (Dudley) LTD.
31 Hall Street, Dudley
Telephone 4474/5
Rewinds, Lighting, Power, Electric Furnace, Electronic Installations and Maintenance. Est. 40 years. E.C.A. Members.

THE TRUMAN ELECTRICAL COMPANY
40-42a Upper Bridge Street, Walsall, Staffs
Telephone 2198 (3 lines)
Electrical Installations, Heating and Ventilating

SOUTH WALES

CLARKE BROS. (Stroud) LTD.
Green Park Street, Aberavon
Telephone: Port Talbot 791
Electrical Engineers and Contractors
Rewinds and Repairs. Industrial Installations

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
117 Woodville Road, Cardiff
Telephone 21281-2 *Telegrams: "Whelect"*

CLARKE BROS. (Stroud) LTD.
High Street, Merthyr Tydfil
Telephone: Merthyr Tydfil 377
Electrical Engineers and Contractors
Rewinds and Repairs. Industrial Installations

MERSEYSIDE & N. WALES

TROUGHTON & YOUNG LTD.
46 Rodney Street, Liverpool 1
Telephone: Royal 9231-2
Electrical Engineers and Contractors

H. J. CASH & CO. LTD.
28 Chapel Street, Liverpool 3
Telephone: Central 0452
Electrical Engineers and Contractors

YORKSHIRE

Electrical Engineers and Contractors
SOUTHERN & REDFERN LTD.
Woodhead Road, Bradford 7
Textile Maintenance, Repairs and Rewinds
Telephones: Bradford 23871—Late Phone: Bradford 65837

DALE ELECTRIC (YORKSHIRE) LTD.
Filey, Yorks. Also at Malton and Driffield
Telephone: Filey 2301 (3 lines)
Manufacturers of the DALE diesel and petrol electric generating plants. All types of electrical contracting. Estimates free and without obligation.

EDMUNDSONS CONSTRUCTION CO. LTD.
Electrical Engineers and Contractors
2 Hartley Hill, Leeds 2
Telephone: Leeds 33791

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
44 Bank Street, Sheffield 1
Telephone 24015 (3 lines) *Telegrams: "Whelect"*

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
Paver Lane, York
Telephone: York 23172

NORTH WESTERN

STEWART THOMSON & SONS (Liverpool) LTD.
Fort Road, Seaforth, Liverpool 21
Repairs and Rewinds A.C. and D.C. to 3,000 horsepower. Breakdowns, Urgent Repairs, etc. 24-hour service
Telephone: Bootle 2697-8

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Telephone: Central 8207-8

Industrial Installations
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Telephone: CENtral 2991-6
Works: Praed Road, Trafford Park, Manchester 17

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Complete Industrial Installations. Rewinds
Netherfield Road, Nelson

H. J. CASH & CO. LTD.
28 Chapel Street, Liverpool 3
Telephone: Central 0452
Electrical Engineers and Contractors

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DALE ELECTRIC (YORKSHIRE) LTD.
Filey, Yorks. Also at Malton and Driffield
Telephone: Filey 2301 (3 lines)
Manufacturers of the DALE diesel and petrol electric generating plants. All types of electrical contracting. Estimates free and without obligation.

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
52 Elswick Road, Newcastle
Telephone: Newcastle 36271

Applications for particulars of costs and standard style of advertisements in this Regional Guide should be addressed to :

THE
ADVERTISEMENT DEPARTMENT,
ELECTRICAL REVIEW,
DORSET HOUSE, STAMFORD STREET,
LONDON, S.E.1

ASSEMBLY WORK

KEMPSTON ELECTRICAL CO. LTD.
KEMPSTON, BEDFORD. Phone: Kempston 2358

CONTROL PANELS
and SPARE PARTS for
AMERICAN CONTROLS

All under one roof!

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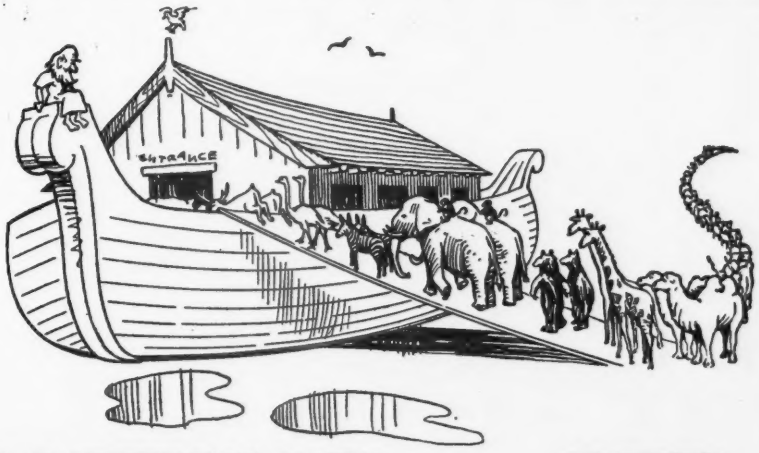
All your requirements are on view in the largest and best equipped Showrooms of DOMESTIC & INDUSTRIAL Electrical Equipment in the Midlands



RICH & PATTISON (B'ham) LTD.

JAMAICA ROW, BIRMINGHAM, 5 *also at* **Ford Street, COVENTRY.**

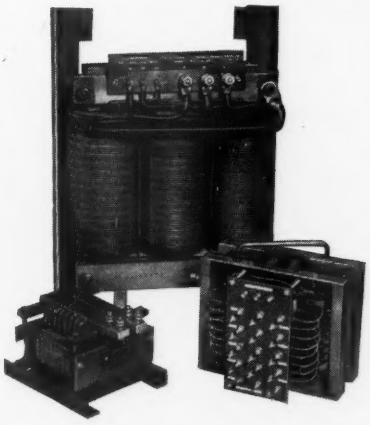
Phone: MID 6714 (6 lines) **Phone: 40501 & 2**

[Cable, Conduit, Conduit Fittings, Switchgear, Motors, Control Gear, Accessories, Electric Tools, Heating & Lighting Fittings and Equipment, Radio, T.V., Domestic Appliances

"EVERYTHING ELECTRICAL"

"Colne" TRANSFORMERS

Range 20 VA to 20 kVA to appropriate B.S.S.



We invite your enquiries.

Manufactured by

Colne

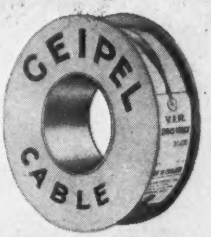
SWITCHGEAR (K & W) LTD.

formerly Electrical Products (Colne) Ltd.

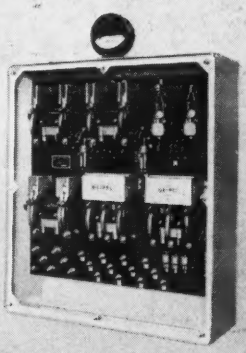
Walton Street, Colne, Lancs.

Phone: Colne 1394/5

RUBBER & THERMOPLASTIC CABLE



TO BRITISH STANDARD SPECIFICATIONS



ELECTRIC CONTROL GEAR

Standard and Special Equipment

WILLIAM GEIPEL LIMITED

ESTABLISHED 1871

156-170 BERMONDSEY ST., LONDON, S.E.1.

Telephone: HOP 0594 (4 lines)

Highland water power

This is Errochty power station on the shore of Locn Tummel. It is the largest generating station in the Tummel-Garry Scheme of the North of Scotland Hydro-Electric Board, and houses three 25 MW vertical-shaft hydro-alternators built and installed by G.E.C. Auxiliary motors and most of the control gear in the station were also supplied by G.E.C.

G.E.C.

HYDRO-ELECTRIC PLANT

THE GENERAL ELECTRIC CO. LTD · MAGNET HOUSE · KINGSWAY · LONDON · W.C.2

Classified Advertisements

CLASSIFIED advertisements are PREPAID at 3/6 per line (approx. 6 words) per insertion. Where an advertisement includes a Box Number there is an additional charge of 1/-.

DISPLAYED CLASSIFIED:—48/- per inch. Cheques and Postal Orders should be crossed and made payable to ELECTRICAL REVIEW PUBLICATIONS LTD.

SERIES DISCOUNTS for consecutive insertions:—13, 5%; 26, 10%; 52, 15%.

SITUATIONS WANTED:—Three insertions under this heading can be obtained for the price of two if ordered and prepaid with the first insertion.

REPLIES to Box Numbers should be addressed to the Box Number in the advertisement, c/o ELECTRICAL REVIEW, Dorset House, Stamford Street, London, S.E.1, but if not to be delivered to any particular firm or individual they should be accompanied by instructions to this effect, addressed to the Manager of the ELECTRICAL REVIEW. Replies in such cases cannot be returned. The name of an advertiser using a Box Number will not be disclosed.

ADVERTISEMENTS are accepted up to **First Post on Monday** of the week of issue and should be addressed to ELECTRICAL REVIEW, Classified Advertisement Department, Dorset House, Stamford Street, London, S.E.1.

Original testimonials should not be sent with applications for employment

OFFICIAL NOTICES, TENDERS, ETC.

BOROUGH OF CHATHAM

Street Lighting Improvements, Trunk Road A.2

TENDERS are invited for (a) the supply of lighting equipment and control gear, and (b) the dismantling of existing equipment, taking down and resiting most of the existing steel columns, the provision and erection of new steel columns and brackets, and the installation of 80 units of horizontal burning mercury vapour lighting equipment rated at 400 watts.

Forms of tender, specification and bill of quantities can be obtained from, and the plan together with the general conditions of contract can be seen at, the office of Mr. J. A. T. Richards, Borough Engineer and Surveyor, Town Hall, Chatham, on payment of a deposit of £2 2s., which will be refunded on receipt of bona fide tenders or the return of all documents.

Tenders must be delivered to the undersigned by midday on Monday, 20th January, 1958.

The Council do not bind themselves to accept the lowest or any tender, and reserve the right to accept both, or either one of tenders (a) and (b).

ROWLAND NEWNES,
Town Clerk.

Town Hall,
Chatham.
17th December, 1957. 1749

BOROUGH OF SUTTON COLDFIELD

Trunk Road A.452, Chester Road North, Street Lighting

TENDERS are invited for the supply and erection of Steel Columns having a mounting height of 25 ft., together with sodium vapour lanterns fitted with 140-watt lamps.

Contract documents may be obtained from, and plans inspected at, the Borough Surveyor's Office, Council House, Sutton Coldfield. A deposit of £2 (two pounds) is required in respect of the documents, which will be returned on receipt of a bona fide tender not subsequently withdrawn.

Tenders in plain sealed envelopes, endorsed "Trunk Road Lighting," to be delivered to the undersigned not later than 12 noon on the 8th January, 1958.

R. WALSH,
Town Clerk.

Council House,
Sutton Coldfield.
13th December, 1957. 1748

COUNTY BOROUGH OF DERBY

Trunk Road Lighting

1. Kingsway, A.5111
2. Broadway, A.5111

TENDERS are invited for the supply of Steel Columns, 140-watt Sodium Lamps, lanterns and gear, etc.

Tender documents, giving details of the two schemes, may be obtained from the Borough Engineer and Surveyor, Council House, Corporation Street, Derby.

Tenders must be delivered, in the addressed envelope provided, to the undersigned, not later than 10 a.m. on Monday, 13th January, 1958.

G. H. EMLYN JONES,
Town Clerk.

Council House,
Derby. 1750

CLASSIFIED ADVERTISEMENTS ARE PREPAID

SITUATIONS VACANT

FEDERATION OF RHODESIA AND NYASALAND

Federal Power Board

Appointment of Operations Controller

THE Board require the services of an OPERATIONS CONTROLLER who should be a fully qualified Electrical Engineer with wide knowledge of all aspects of the operation of electricity supply systems, including the commercial aspects, and who should possess executive experience.

The Board are at present constructing at the Kariba Gorge on the Zambezi a large dam and power station having an initial capacity of 500 MW and an ultimate capacity of at least 1,200 MW. The Board are also constructing about 930 miles of 330-kV transmission line to connect the Kariba power station with a number of thermal stations in the Federation. The Operations Controller is required in connection with the operation of this integrated system.

Salary £3,500 per annum. There is a pension scheme which the successful applicant will be required to join.

Applications should be posted so as to reach the Secretary, Federal Power Board, Reliance House, P.O. Box 630, Salisbury, Southern Rhodesia, not later than 31st January, 1958.

1725

CENTRAL ELECTRICITY AUTHORITY

South Western Division

SENIOR DRAUGHTSMEN and ENGINEERING DRAUGHTSMEN in the Generation Construction Department at Bristol. Superannuation scheme. Salary N.J.B. Schedule D, Grades 5 or 6, £760-£860 or £595-£715 per annum.

Applicants should preferably have experience in layout of power station mechanical equipment, or in layout and diagrams for electrical auxiliary plant.

THIRD ASSISTANT ENGINEER (Control) in the System Operation Department, Bristol. Superannuation scheme. Salary N.J.B. Class AX/EX, Grade 6, £895-£1,020/£1,140 plus 10% for shift duties.

Duties will cover switching, load despatching and general shift work in the Bristol Grid Area control room.

Applicants should be Grad. I.E.E. or equivalent and should have had experience in a steam power station.

Applications on form A.E.6/ACT, obtainable from the Divisional Secretary, 26, Oakfield Road, Bristol, 8, should be completed and returned by 4th January, 1958. 1747

SOUTHERN ELECTRICITY BOARD

Installation Engineer

Aldershot District of No. 3 (Portsmouth) Sub-Area. Salary N.J.B. Class G, Grade 8 (£885 × £15 to £930 per annum). N.J.B. conditions of service.

Applicants should be qualified to organise and control all installation and maintenance work in the District and branches and to collaborate with the Development Engineer and District Commercial Engineer in the preparation of contracting schemes of a large or exceptional nature.

The successful candidate will be required to contribute to the Central Electricity Authority and Area Boards (Staff) Superannuation Scheme if eligible.

Applications on forms obtainable from the Sub-Area Secretary, Lower Drayton Lane, Cosham, Portsmouth, and returned to him in envelopes suitably endorsed not later than 6th January, 1958.

Installation Inspector

Uxbridge District of No. 1 (Southall) Sub-Area, located at Waterloo Road, Uxbridge. Wages in accordance with the National Joint Industrial Council Agreement for the Electricity Supply Industry, i.e., 62.50d. per hour.

The duties of the post will be as defined in Schedule B of the National Joint Industrial Council Agreement for the Electricity Supply Industry. Applicants should have a good knowledge and experience in electrical wiring installations, domestic and industrial, and be familiar with the regulations for the electrical equipment of buildings issued by the Institute of Electrical Engineers and the various codes of practice issued by British Standards Institute as far as they relate to the duties of an Installation Inspector.

Applications, in writing, giving details of age, experience, etc., to the Sub-Area Secretary, 2/6, Windmill Lane, Southall, Middlesex, so as to reach him not later than 6th January, 1958. 1741

CITY OF NORWICH

City Engineer's Department

Assistant Electrical Engineer

APPLICATIONS are invited for the above appointment at a salary in accordance with A.P.T. Grade II (£725-£845), Grade III (£845-£1,025) or the Special Grade (£750-£1,030) according to experience and qualifications. Applicants must have the Higher National Certificate or be Graduates of the Institution of Electrical Engineers, have served an apprenticeship in electrical installation work, and have had experience in the design and supervision of street lighting and interior lighting and power installations.

The appointment is terminable by one month's notice on either side and subject to the provisions of the Local Government Superannuation Act, 1953. The successful candidate will, therefore, be required to pass a medical examination. Relationship of applicant to members of the Council or staff must be declared in the application. Canvassing directly or indirectly will be a disqualification. Applicants should state age, qualifications, training, experience, present and previous positions, giving salaries and dates, together with names of three referees.

Applications should be delivered to H. C. Rowley, M.I.C.E., City Engineer, City Hall, Norwich, not later than 10 a.m. on Thursday, 2nd January, 1958. 1735

***Situations Vacant** (continued)*

ENGINEER FOR COMMISSIONING AND TESTING DEPARTMENT

Candidates for this post must produce evidence that their past experience is such as will fit them to take complete charge of the commissioning of modern power plant (mechanical) and of its subsequent operation until taken over by the client.

The duties of the successful candidate, in the first place, will be abroad, but subsequently he will be attached to the London office with absences from London for periods up to six months at a time. A knowledge of testing techniques as applied to boilers, turbines, cooling towers, dust collectors and auxiliary plant is desirable.

The minimum age requirement is 35 years and, while good technical qualifications are highly desirable, the lack of such qualifications will not necessarily debar a candidate.

ENGINEER FOR TECHNICAL ENGINEERING DEPARTMENT

Duties are the preparation of general schemes for and detailed engineering of new thermal and nuclear energy power plants, both industrial and central, and the technical analysis of existing plants. Candidates will be expected to provide evidence that their technical and practical background is such as will enable them to assess correctly a client's plant requirements and also to determine the suitability of plant offered by a manufacturer. The work involves a knowledge of thermodynamics, fluid flow mechanics, physics, and the application of these to power plant problems; for these reasons the possession of a good technical qualification in engineering is desirable. The successful candidate would be centred in London, but will be expected to undertake short visits to plant sites as required.

Applications giving details of training, qualifications and experience to date for the above positions should be sent to the Personnel Officer, Ewbank & Partners Ltd., 10/11 Grosvenor Place, London, S.W.1. 1757

NORTH WESTERN ELECTRICITY BOARD

SECOND ASSISTANT ENGINEER, SUB-AREA CONSUMERS' ENGINEER'S DEPT., MANCHESTER.

Applicants should be qualified to advise consumers on the application of electricity to industrial processes, especially in the engineering, chemical and textile industries. Some knowledge of space and process heating is desirable.

Corporate Membership of the Institution of Electrical Engineers will be an advantage.

Salary scale £1,325 × £30 to £1,415, Grade M.7. N.J.B. conditions.

Applications, naming three referees, to Sub-Area Secretary, No. 1 Sub-Area, North Western Electricity Board, Town Hall, Manchester, P.O. Box 493, by 4th January, 1958.

SECOND ASSISTANT ENGINEER, SUB-AREA CONSUMERS' ENGINEER'S DEPT., BOLTON.

Applicants should have experience in the utilisation of electricity in industry, with particular reference to the textile, mining, engineering and chemical industries, change-over from D.C. to A.C., and public lighting.

Corporate Membership of the Institution of Electrical Engineers will be an advantage.

Salary scale £1,235 × £30 to £1,325 per annum, Grade L.7. N.J.B. conditions.

Applications, naming three referees, to Sub-Area Manager, No. 2 Sub-Area, North Western Electricity Board, 2, St. George's Road, Bolton, by 4th January, 1958. 1683

SOUTH WALES ELECTRICITY BOARD

APPLICATIONS are invited for the position of ASSISTANT ENGINEER, District 104 (Lampeter) in the Western Sub-Area of the Board.

Salary Class C, Grade 9 (£635/£680) of the N.J.B. Agreement.

Applications stating age, present position and salary, qualifications, experience, and three referees, should be addressed to the Secretary (Establishments Section), St. Mellons, Cardiff, so as to reach him not later than Friday, 3rd January, 1958. 1753

CENTRAL ELECTRICITY AUTHORITY

Yorkshire Division

APPLICATIONS are invited for an appointment as FOURTH ASSISTANT ENGINEER in the Technical Department based on Keadby, near Scunthorpe.

Commencing salary within the range £710-£835 per annum, Class AX, Grade 8, according to qualifications and experience, rising to an ultimate maximum of £935 per annum (Class EX).

Applicants should possess technical qualifications leading to Corporate Membership of the Institution of Electrical Engineers and should have had some experience of protective equipments applied to high-voltage generation and transmission systems. Works experience will be an advantage.

Application forms obtainable from the Divisional Secretary (Establishments), Central Electricity House, St. Mary's Road, Leeds, 7, to be returned within 14 days of the appearance of this advertisement. 1745

ENGLISH ELECTRIC

OFFERS CAREERS TO YOUNG MEN HAVING AT LEAST O.N.C. (ELECTRICAL) AND PRACTICAL EXPERIENCE.

A Training Course is being arranged on the company's heavier range of Switchgear.

On satisfactory completion, appointments will be made to the Applications Section or to the Circuit Breaker Design and Development Section of the Switchgear Engineering Department, Stafford. The former department is actively engaged in the engineering of switchgear schemes relating to a variety of generation and utilisation projects, while the latter is engaged on long-term development of circuit breaking equipment.

Generous salaries will be paid during training. Help will be given with removal expenses and accommodation.

All applications will be treated confidentially.

Write giving full details to Central Personnel Services, 336/7, Strand, London, W.C.2, quoting Ref. ER.1201B.

356

THE ENGLISH ELECTRIC COMPANY

seeks to recruit young men to train for their Heavy Electrical Machine Design staffs at their Stafford and Mersevside works. To this end they are offering

A SHORT INTENSIVE COURSE

in modern design techniques by senior engineers of the company, supplemented by instruction in drawing office procedure and sufficient practical training in the works.

Applicants should have completed or be exempt from National Service and should possess one of the following qualifications :—

(a) Degree in Engineering, Physics or Mathematics.

(b) Higher National Diploma or Certificate (Electrical or Mechanical).

Please apply with full details to Dept. C.P.S., Marconi House, 336/7, Strand, London, W.C.2, quoting Ref. ER415A.

1742

SOUTHERN RHODESIA ELECTRICITY SUPPLY COMMISSION

Central Workshops, Salisbury

TRANSFORMER REWINDER required. Salary scale £1,050 to £1,200 gross per annum.

Applicants should be completely conversant with all stages of assembly of large power transformers including O.L.T.C. units and should have a thorough knowledge of rewinding and repairs to all types and sizes of transformers, particularly large units.

Preference will be given to applicants having had a period of service with a large transformer manufacturer.

Subject to the signing of a contract for three years' service, passages to Rhodesia will be paid.

Application forms may be obtained from the Secretary (R), Rhodesia House, 429, Strand, London, W.C.2, and completed application forms should be forwarded by air mail to the Secretary, P.O. Box 377, Salisbury, Southern Rhodesia by 18th January. 1720

INSTRUCTION BOOK WRITER

'ENGLISH ELECTRIC'

STAFFORD

THE company wishes to appoint a Technical Writer interested in the compilation of operating procedures and installation and maintenance instructions associated with POWER SYSTEM METERING AND RELAY EQUIPMENT.

Applicants should have a sound technical background, preferably in the light current manufacturing or operating fields. They should also have a flair for written expression.

Applications, which will be treated confidentially, should contain details of age, qualifications, experience, present position and status.

Please write to the Central Personnel Services, 336/7, Strand, London, W.C.2, quoting Ref. ER.1292B.

357

ARMATURE WINDING AND GENERAL ELECTRICAL REPAIRS

OLD-established North-East Coast Electrical Engineers and repairers require the following staff :—

1. ASSISTANT BRANCH MANAGER.
   Must have full knowledge of modern electrical and mechanical repair techniques. The post offers an opportunity for a keen man with right personality.
2. WINDING SHOP FOREMAN.
   Applicant must be familiar with small motors and tool repairs. Progressive post to right man.
3. INSTALLATION CONTRACTS MANAGER.
   Must be fully experienced in estimating and labour control. Progressive post.

Pension and bonus schemes are in operation.

Write—Box 1726.

BRITISH KLOCKNER SWITCHGEAR LIMITED

Chertsey, Surrey

TECHNICAL SALES ENGINEERS required for London and Home Counties. Knowledge of motor control gear; sales experience preferred but not essential. Apply giving full particulars to—Managing Director. 166

LONDON ELECTRICITY BOARD

Assistant Distribution Engineer

APPLICATIONS are invited for the above position in the Board's Eastern District at Stratford, London, E.15.

Applicants should have had a sound technical education up to at least Higher National Certificate standard, preferably being Corporate Members of the I.E.E., and possess a practical experience of all branches of engineering work associated with the organisation of a District distribution department, particularly in regard to mains and substation work.

The post is graded under Schedule "A" of the National Joint Board Agreement as Class J, Grade 12, £830 per annum, rising to £885 per annum, inclusive of London allowance.

Application forms obtainable from Personnel Officer, 46, New Broad Street, London, E.C.2, to be returned completed by 4th January, 1958. Please quote ref. PER/2367/R. 1689

ATOMIC POWER CONSTRUCTIONS LIMITED

THE above company, which is engaged in the design, construction and commissioning of nuclear power stations, invites applications from chartered engineers for several posts.

The vacancies for which applicants are now being considered are SITE RESIDENT ENGINEER to supervise the construction of complete power stations, and for MECHANICAL, ELECTRICAL and CIVIL ENGINEERS to act as assistants to the Site Engineer.

Vacancies also exist for SITE COMMISSIONING ENGINEER and MECHANICAL and ELECTRICAL ASSISTANTS.

These are senior appointments and rates of pay and service conditions will be appropriate.

Applications should be by letter addressed to

The Secretary (Ref. JNB)
ATOMIC POWER CONSTRUCTIONS LTD.
28, Theobalds Road, London, W.C.1
1754

SOUTH WALES ELECTRICITY BOARD

Appointment of Deputy Chief Engineer

APPLICATIONS are invited for the position of DEPUTY CHIEF ENGINEER at the Board's Head Office, St. Mellons, Cardiff.

The successful applicant will be required to deputise for the Chief Engineer in all matters.

Applicants should preferably be chartered electrical engineers.

The conditions of service are as laid down by the National Joint Managerial and Higher Executive Grades Committee, and the salary will be within the range of £2,300 to £2,600 per annum.

Applications giving full details should be addressed to the Secretary at the Board's Headquarters, St. Mellons, Cardiff, so as to arrive on or before Monday, 20th January, 1958.

Envelopes should be clearly marked "Deputy Chief Engineer." 1756

SOUTH OF SCOTLAND ELECTRICITY BOARD

APPLICATIONS are invited for a position as SHIFT CHARGE ENGINEER at Bonnybridge Generating Station, near Falkirk. Applicants should have had generating station experience and preferably possess a Higher National Certificate in Electrical or Mechanical Engineering. Salary N.J.B. Class F, Grade 7, £885/£930 per annum, plus shift allowance of 10%. The position is superannuable.

Forms of application to the Secretary, South of Scotland Electricity Board, 168, Broomhill Drive, Glasgow, W.1, not later than 10th January, 1958. 1752

ELECTRICAL ENGINEER

LARGE firm of Electrical Contractors in the Glasgow area requires an ASSISTANT ENGINEER to operate directly under Departmental Manager.

Manager/administrator type with minimum Higher National Certificate/Degree in Electrical Engineering, and with 5/7 years' experience in industry or contracting.

Starting salary would be from £900 p.a. according to qualifications and experience.

Applications in strict confidence to Box 1728.

CENTRAL ELECTRICITY GENERATING BOARD

Headquarters

SENIOR ASSISTANT ENGINEER (Operations) required in Nuclear Power Sub-Department at London Headquarters to assist in duties concerned with the operational aspects of nuclear power stations. Candidates should preferably hold a degree in engineering and be Corporate Members of the Institution of Mechanical and/or Electrical Engineers. They should also have good experience in the administration, operation and maintenance of modern power stations.

Salary within scale £1,435-£1,795 per annum.

Applications stating age, qualifications, experience, present position and salary should be forwarded to S. S. Scott, Chief Personnel Officer, 24-30, Holborn, London, E.C.1, by 11th January. Quote ref. E.R./4. 1755

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

FOURTH ASSISTANT ENGINEER required in the Planning Section at No. 1 Sub-Area Headquarters, Liverpool. Salary within range £835/£880 per annum (N.J.B. L/13).

Applicants should have had experience in all aspects of the distribution of electricity and possess knowledge of the technical and economic principles underlying the design of distribution systems, and should possess suitable technical qualifications.

Appointment subject to medical examination. Pension scheme.

Special application forms, obtainable from the Manager, No. 1 Sub-Area, 24, Hatton Garden, Liverpool, 3, should be returned not later than 11th January, 1958. 1746

CHIEF ESTIMATOR

LARGE firm of Electrical Contractors in the Glasgow area requires a CHIEF ESTIMATOR capable of forming and taking charge of an Estimating Department. Applicants must be competent to estimate for competitive schemes in internal lighting and power schemes for industrial and public building.

Engineering: Power station installations and cabling to 33 kV; U/G distribution.
Supervise only: O/H/L distribution and electrical services to other engineering plant.

Starting salary from £900 per annum according to qualifications and experience.

Applications giving full details in strict confidence to—Box 1727.

DESIGNER OF INDUSTRIAL LIGHTING EQUIPMENT

Applications for the above appointment are invited by

THE BENJAMIN ELECTRIC LIMITED.

Knowledge of fabricating techniques, finishes, lamps and control gear desirable, but initiative and ideas equally important.

The vacancy carries excellent prospects, with appropriate salary according to age, experience and qualifications. Staff luncheon room and pension scheme.

Apply Chief Technical Engineer, Brantwood Works, Tottenham, London, N.17. 177

NORTH WESTERN ELECTRICITY BOARD

GENERAL ASSISTANT ENGINEER, SUB-AREA ENGINEER'S DEPARTMENT, MANCHESTER.

Applicants should have experience of general testing work, with particular reference to protective equipment. The duties will include the commissioning tests of protective equipment in substations. Preference will be given to applicants who hold the H.N.C. in Electrical Engineering, or its equivalent.

Salary scale £540 × £15 to £585, Grade M.20. N.J.B. conditions.

Applications, naming three referees, to Sub-Area Secretary, No. 1 Sub-Area, North Western Electricity Board, Town Hall, Manchester, 2, by 6th January, 1958. 1751

APPLICATIONS are invited for the position of foreman electrical engineer. Applicants must have extensive knowledge of alternators and direct current generators up to 500 kW and be fully conversant with latest control equipment. The salary offered is £750 per annum and a bonus system will operate.—Box 1729.

CIRCUIT design draughtsmen required by company manufacturing industrial control equipment. Good salaries paid to "first-class" men. Canteen facilities, pension scheme. Housing assistance considered in approved cases. Write giving age, experience, etc., to—Personnel Officer, Dewhurst & Partner Ltd., Inverness Works, Inverness Road, Hounslow, Middx. 273

CONSULTING engineers require for tour of duty in Iran qualified and experienced mechanical and electrical engineer. Duties will cover local design work and negotiations with clients, together with control of supervision of large mechanical and electrical installation contracts associated with airport construction and other projects. Attractive salary and allowances. Apply—Box 1730.

CONTRACT engineer required for switchgear company in South Africa. Must be experienced in handling switchgear contracts up to 33 kV, including the checking of connection diagrams and the ordering of protective gear and other associated equipment. Education up to Higher National Certificate level would be an advantage. Minimum period of engagement three years. Passage paid. Salary £100/£120 per month. Applicants should apply, stating age and experience, to—Box 1743.

CROMPTON PARKINSON Ltd., Chelmsford, Essex, invite applications for the position of indoor sales engineer. Applicants would be required to handle enquiries for rotating electrical plant and control gear up to 1,500 h.p./kW, and must have had a sound engineering training and preferably experience in preparing tenders for plant required in power stations, factories and similar installations. Five-day week; contributory superannuation scheme. Please write giving age and details of education and experience to — Personnel Officer. 1731

DEWHURST & PARTNER Ltd. require technical estimator for preparing tenders in their estimating engineering department. Applicant must have good electrical engineering background and have basic knowledge of motor control equipment and its applications. The position is a senior one, and housing assistance will be given to successful applicant if necessary. Canteen facilities, pension scheme. Write giving age, experience, etc., to — Personnel Officer, Dewhurst & Partner Ltd., Inverness Works, Inverness Road, Hounslow, Middlesex. 274

DRAUGHTSMAN wanted, electrical experience an advantage. Opportunity for ambitious man in Westminster office. Write age, experience and salary required.—Box 1672.

ELECTRO-mechanical draughtsmen required for production drawing office of company engaged in the manufacture of control gear equipment. Good salaries paid to "first-class" men. Canteen facilities, pension scheme. Housing assistance considered in approved cases. Write giving age, experience, etc., to—Personnel Officer, Dewhurst & Partner Ltd., Inverness Works, Inverness Road, Hounslow, Middx. 275

ESTIMATING and contract engineer required for each of the following departments: Cable department; transformer department. Applications addressed to Box 1732, will be forwarded to Montreal, Canada.

EXPERIENCED draughtsmen required for interesting design work on process plant and machinery. A good technical background and knowledge of machine design is essential and applicants should be qualified to H.N.C. standard. Salaries are assessed in accordance with age, qualifications and experience and will be reviewed annually. Contributory superannuation and widows' pension fund are in operation and there are excellent canteen, welfare and recreational facilities. Applicants should apply in writing to the Chief Engineer, Pilkington Brothers Limited, Cowley Hill Works, St. Helens, enclosing a brief history of their career and details of their education and qualifications. 1736

LONDON consulting engineers require electrical engineers for installation design for hospitals, commercial buildings, schools, etc. Write stating age, qualifications, experience and salary required to—Box 160.

***Situations Vacant** (continued)*

MAX ARC & ELECTRICS Ltd., Terrace Road, Walton-on-Thames, Surrey, are a small progressive firm of electrical engineers and they require an electrical draughtsman who is also interested in technical sales and executive work. 1738

PLANT superintendent with suitable electrical qualifications required for furniture factory. Good conditions and salary. Apply—Works Manager, Dancer & Hearne Bros. Ltd., Penn Street, Nr. Amersham (Tel. Holmer Green 3154). 1673

PORT OF LONDON AUTHORITY invite applications for the position of engineering inspector (electrical) on their established pensionable staff. Scale of pay £843 per annum, rising by annual increments to the maximum of £956 per annum. Applicants, who should be under 50 years of age, are required to possess sound knowledge of the principles concerning both high-voltage and low-voltage distribution, including switchgear, transformers, cables, pumps, rectifiers and associate protection, and automatic controls. Experience in the control and management of labour is desirable. Applications giving age and full details of experience should be addressed to the Establishment Officer, Port of London Authority, Trinity Square, London, E.C.3. 1744

TESTER of automatic electric control equipment required. Interesting work with good prospects. O.N.C. standard preferred. Five-day week, pension scheme, canteen facilities. Please write giving full details of age, previous experience, qualifications, etc., to—Personnel Officer, Dewhurst & Partner Ltd., Inverness Road, Hounslow, Middlesex. 277

THE RHEOSTATIC Company Limited, Slough, Bucks., require electrical engineer, age 25/30, with Higher National Certificate and experience with temperature controls or similar equipment, for vacancy in home sales department, Slough. Applications, stating education, experience and salary to — Home Sales Manager. 1717

TRANSFORMER draughtsmen, senior and junior, for all types up to 500 kVA. Good salary and housing assistance if needed for the right men.—Transformers & Rectifiers Ltd., Millmead, Guildford. 1694

VACANCIES occur for skilled plumber-jointers with experience in jointing all types of cables, preferably up to and including 11 kV. These vacancies arise from extensive contract works in the Home Counties. Good working conditions and London rates of pay.—Box 1680.

APPOINTMENTS FILLED

Dissatisfaction having so often been expressed that unsuccessful applicants are left in ignorance of the fact that the position applied for has been filled, may we suggest that Advertisers notify us to that effect when they have arrived at a decision? We will then insert a notice free of charge under this heading.

SALES BY AUCTION

Twenty-seventh Sale **E. R.**

By Order of the Secretary of State for Air

R.A.F., STAFFORD
(on the main Sandon road, 2 miles from Stafford Centre).

SOUTH & STUBBS
are instructed to Sell by Auction on
WEDNESDAY, 8th JANUARY, 1958
at 11 a.m., at R.A.F., Stafford,
a large quantity of
SURPLUS GOVERNMENT STORES

on No. 7 Site, R.A.F., Stafford, including Radio and Aero Spares, Engine Spares, Bamford Engines, Generators, Bicycles, various Plant Spares, Parachutes, Barrack Furnishings, Wood Cases, Aerial Masts, Caterpillar Track Frames, etc.

On view Tuesday, 7th January, from 10 a.m. to 4 p.m. and morning of Sale.

Catalogues, 6d. each (P.O. only) from the Auctioneers.

Auctioneers' Offices:
28, Eastgate Street, Stafford (Tel. 2331/2). 1734

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LARGE A.C. MOTORS

3-phase, 50 cycles

Maker.	h.p.	Volts.	r.p.m.
B.T.H.	1820	3.3 kV	368
B.T.H.	1800	400/440	368
B.T.H.	1400	6.6 kV	368
MATHER & P.	350	400/440	730
MATHER & P.	300	400/440	750
B.T.H.	275	400/440	485
B.T.H.	250	400/440	480
BRUSH	250	400/440	420
MATHER & P.	200	400/440	960
E.C.C.	175	400/440	580

Reconditioned and guaranteed.

THOS. W. WARD LTD.
Albion Works, Sheffield
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G. F. WALKER & SON
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50 SIMPLEX B.E. Watertight Switches	£8
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24 gr. WALSALL 1¼" Brass Ring Bushes	£60
88 doz. Round Conduit Boxes, galv., ⅝", 4-way	£60
42 doz. G.E.C. ⅝" B.E. Through Boxes	£20
24 gr. G.E.C. 2" Galv. Crampets	£20
45 doz. G.E.C. ⅝" B.E. Back Plates	£11

60, June Avenue, Leicester
(Phone: Syston 3198) 1681

REDUCE YOUR MAXIMUM DEMAND

NEARLY new WATFORD Load Control equipment at only 30% of new price. If you have adequate compressed air storage, arc furnaces, heat treatment furnaces, direct electrical heating and can shut off the equipment for a few minutes in any half-hour then this equipment will repay itself in a few months.

Contact—Box 1739.

ELECTRIC HOUSE SERVICE METERS

PREPAYMENT and credit, 200/250 v. A.C., s/p., 50 c., 2½-100 A. Fixed or variable tariff. Reconditioned, fully tested and guaranteed 2 years. Prompt delivery, carriage paid.

ALBERICE METER COMPANY
Fairfax Works, Fairfax Rd., London, N.8
(Tel. MOUntview 7944, 6373) 191

ABABCOCK & Wilcox water tube boiler will cut down your fuel costs; we can supply from stock. Two 40,000 lb. evap., 220 lb. w.p.; one 25,000 lb. evap., 200 lb. w.p.; 3,000 lb. evap., 400 lb. w.p.; Spencer Bonecourt boiler; also Marine, Cornish vertical, etc.—Burford, Taylor & Co. Ltd., Boiler Specialists, Burtayco House, Church Street, Middlesbrough (Tel. Middlesbrough 2622). 122

A.C. and D.C. motors, generators, from stock.—Service Electric Co. Ltd., Honeypot Lane, Stanmore, Middx. (Edgware 5566/9). 91

A.C. and D.C. 1/- Slotmeters. Guaranteed 2 years, 2½-50 amps. From 50/-. Repairs and recalibrations. See Billiard: Tradex Meter Co., Surbiton (Tel. Elmbridge 4487). 169

ALTERNATORS from ½ to 675kVA in stock, single and three-phase, all voltages and frequencies. Guaranteed. Many unused. Send your requirements.—Fyfe, Wilson & Co. Ltd., Station Works, Bishop's Stortford. 162

ALTERNATORS, generators, 1-100 kVA, all voltages. Specialists—Powerco Ltd., 312, York Rd., London, S.W.18 (VAN. 5234). 147

ALTERNATORS, 3-phase, all sizes in stock from 7 kVA up to 330 kVA.—Britannia Manufacturing Co. Ltd., 20/26, Britannia Walk, London, N.1 (CLErkenwell 5512). 24

BARGAINS in electric motors are always being obtained from A. Cooksley & Co. Ltd., 21/25, Tabernacle Street, London, E.C.2. Stocks include A.C. and D.C. motors, second-hand and new up to 30 h.p. Starters, slide rails and pulleys. Ring Mon. 3355 for your requirements. 50

BILLIARD Meters. 1/-, 6d. or 1d. slot. All time settings. From 140/-. See Quarterly.—Tradex, Surbiton. 170

CABLE, underground, all types ex stock.—E. M. Tatton Co. Ltd., Kew Bridge, Brentford (EALing 3155/6). 117

CABLE, underground, PILC/VIR/LC, ex London stock. Cutting orders same day delivery London area. Send for priced stock lists.—Batt Electrical Co., 6, Dock Street, London, E.1 (Tel. ROYal 5905). 316

CIRCUIT breakers, various sizes in stock, A.C. and D.C., 200 amperes up to 2,000 amperes. Also dynamo and alternator switchboards. — Britannia Manufacturing Co. Ltd., 22/26, Britannia Walk, London, N.1. 26

CONVERTERS, 110 and 220 v. D.C./230 v. A.C., .5 to 6kVA; also A.C./D.C. Special voltages at short notice.—Powerco Ltd., 312, York Rd., London, S.W.18 (VAN. 5234). 150

CRANE motors. Direct current, series wound or compound wound, all voltages. We have large stocks.—Britannia Manufacturing Co. Ltd., 22/26, Britannia Walk, London, N.1. 22

DIESEL generating sets, all sizes to 500 kW. Britannia Mfg. Co. Ltd., Britannia Walk, London, N.1. 16

ELECTRIC motors, dynamos, alternators and motor generator sets of all sizes. We hold one of the largest stocks in England. New and reconditioned, with 12 months' guarantee.—Britannia Manufacturing Co. Ltd., Britannia Walk, London, N.1 (Clerkenwell 5512, 3 lines); also Works and Stores, Chobham, Surrey. 20

ELECTRIC motors, generators, control gear, transformers, A.C. and D.C., new and reconditioned; all covered with our usual 12 months' guarantee; large stocks available.—Electropower Co. Ltd., Kingsbury Works, Kingsbury Road, London, N.W.9 (Colindale 4621-2). 42

ELECTRIC motors, generators, motor generator sets, transformers, switchgear, etc., large comprehensive stock, overhauled and guaranteed. Copy of our Register, "Electrical Surplus," containing thousands of items of electrical plant, sent on request.—R. F. Winder Ltd., Belgrave Electrical Works, Leeds, 2. 54

ELECTRICIANS. Send for details Shaftesbury lightweight "Bantam" ladders. Top sections fitted with patent moulded rubber blocks, eliminate possibility of scratching or marking walls, fascias, and other painted or highly polished surfaces. Also available for immediate delivery, steps, platform steps, trestles, telescopic trestles, pole and builders-type ladders, and all sizes of two and three-section extension ladders.—Shaftesbury Ladders Ltd. (E.R.), 453, Katherine Road, London, E.7 (Phone: Grangewood 3363/4). 111

FLUORESCENT fittings, lamps, starters and control gear for home and export. Fully guaranteed by actual manufacturers. Send for catalogues. — The Anglo-American Electrical Company, Olive Street, Bury, Lancs. 245

FLUORESCENT tubes reconditioned and guaranteed as new for 7s. 6d. each. Free collection and delivery in Lancs and Yorks.—The Anglo-American Electrical Company, Bury New Road, Breightmet, Bolton, Lancs. (Telephone, Bolton 7251). 212

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AERIALITE LTD.

Achievements in a Difficult Year

THE 25th Annual General Meeting of Aerialite Limited was held on 19th December at Stalybridge, Cheshire, Mr. L. S. Hargreaves (Chairman and Managing Director) presiding.

The following is an extract from his circulated statement:—

I am able to put forward a balance sheet which shows that during the year we have again increased our profit. Our sales have kept up very satisfactorily during this year and our expansion is still proceeding.

We have again executed during the year, orders for most of the Government and Service Departments and the building industry, and we have supplied our products to a very large and wide range of industries. We have supplied the whole of the wiring (approximately 100 miles) for the equipping of the new independent television station for T.W.W. Ltd. (Wales and The West), at Cardiff. As far as we are aware this is the first television station which has been completely equipped with Aerialite cable. Also during the year we have supplied the whole of the cable, including armoured cable, for the largest coal washing plant in Europe at Manvers Main Colliery.

It seems that the credit squeeze has not affected us adversely and the sales of television and radio have kept up remarkably well. We have been able to maintain our sales although we have had to work harder to achieve the turnover.

In spite of keen competition in the cable business, we have maintained our turnover and profit — which is a remarkable performance bearing in mind that prices of raw materials have dropped considerably during the year, and therefore we have had to increase our volume very much to offset the lower prices. We have achieved this satisfactorily, and I am very pleased that this difficulty has been overcome.

The factory at Congleton which is now in its third year of operation is very successful, and our television aerial business has expanded considerably. New records have been achieved, and we believe, without question, we are producing the best television aerials in the business —both as regards design and quality, and the trade are using them in greater numbers continuously.

The sales of our patented coaxial cables have been maintained and, at the time of this report, they are in very great demand indeed.

Steady Demand for all Products

During the year there has been a steady demand for all our products, and we have been able to increase our stock in the quieter periods of April, May and June—which has helped to increase our sales at the busy season, the benefit of which is being felt at present.

I am pleased to report that we have increased our export trade during the year, and although this business is very competitive we seem to get an increasing share of the business.

The profit of Aerialite Ltd., before taxation, is up from £275,146 last year to £366,391 this year, and the Group from £369,692 to £458,404, which I feel sure the shareholders will agree is a satisfactory result, especially in view of the continuing credit squeeze and falling material prices. I think that the results show that our Group of Companies is broadly based and shows resilience to be able to produce these results under the conditions ruling.

In the first six months of the running year, we are still further up in sales and profits and the trend continues.

An Interim Dividend of 19%, less income tax, on the Ordinary Stock was paid in May, 1957, and your Directors recommend a Final Dividend of 32½%, less income tax, on the Ordinary Stock as against 18% and 30% respectively last year.

The report was adopted.

1724

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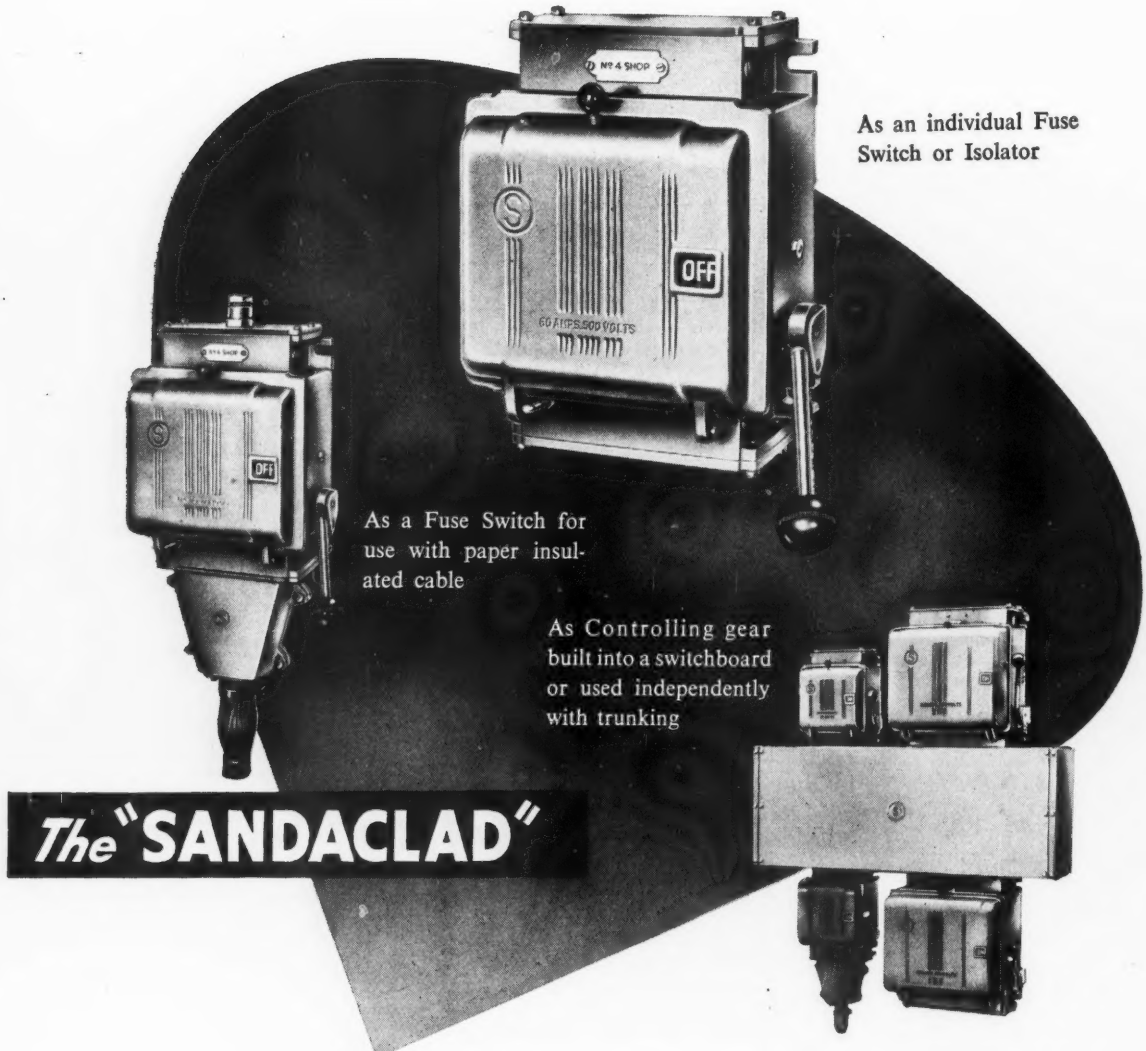

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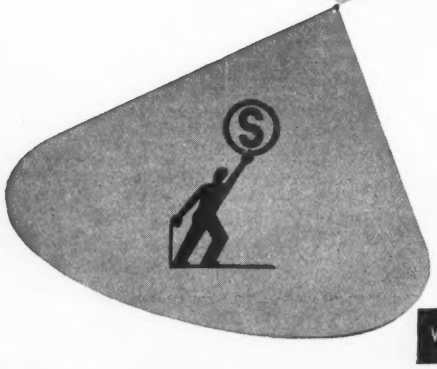

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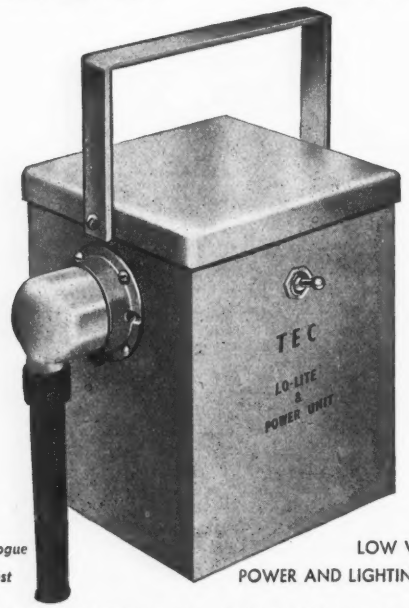

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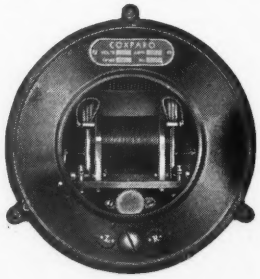

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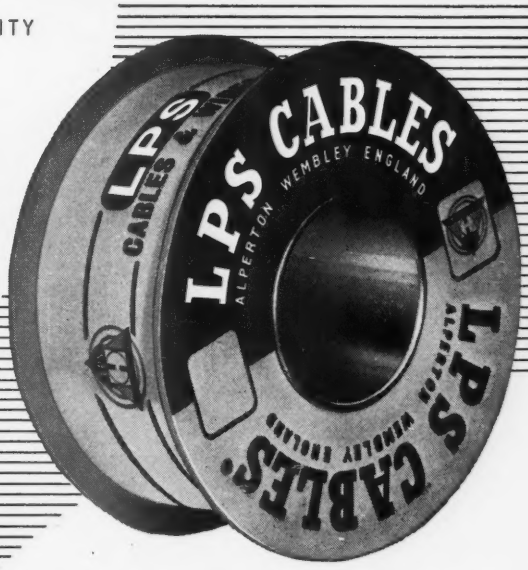

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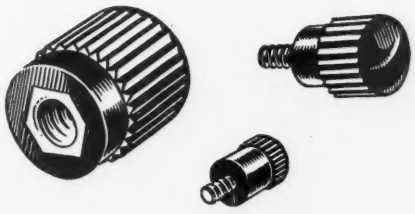

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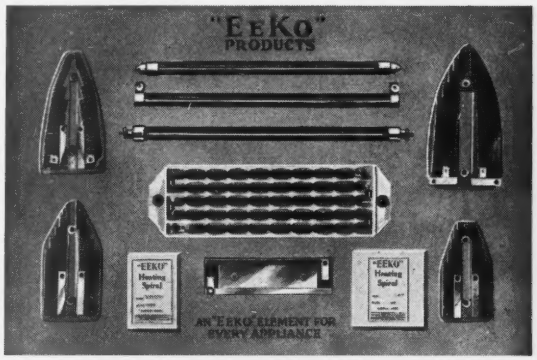

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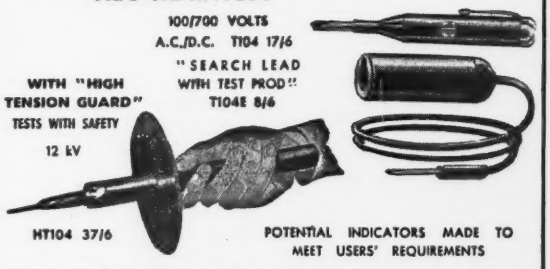

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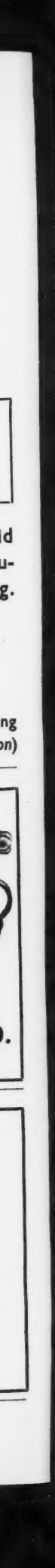

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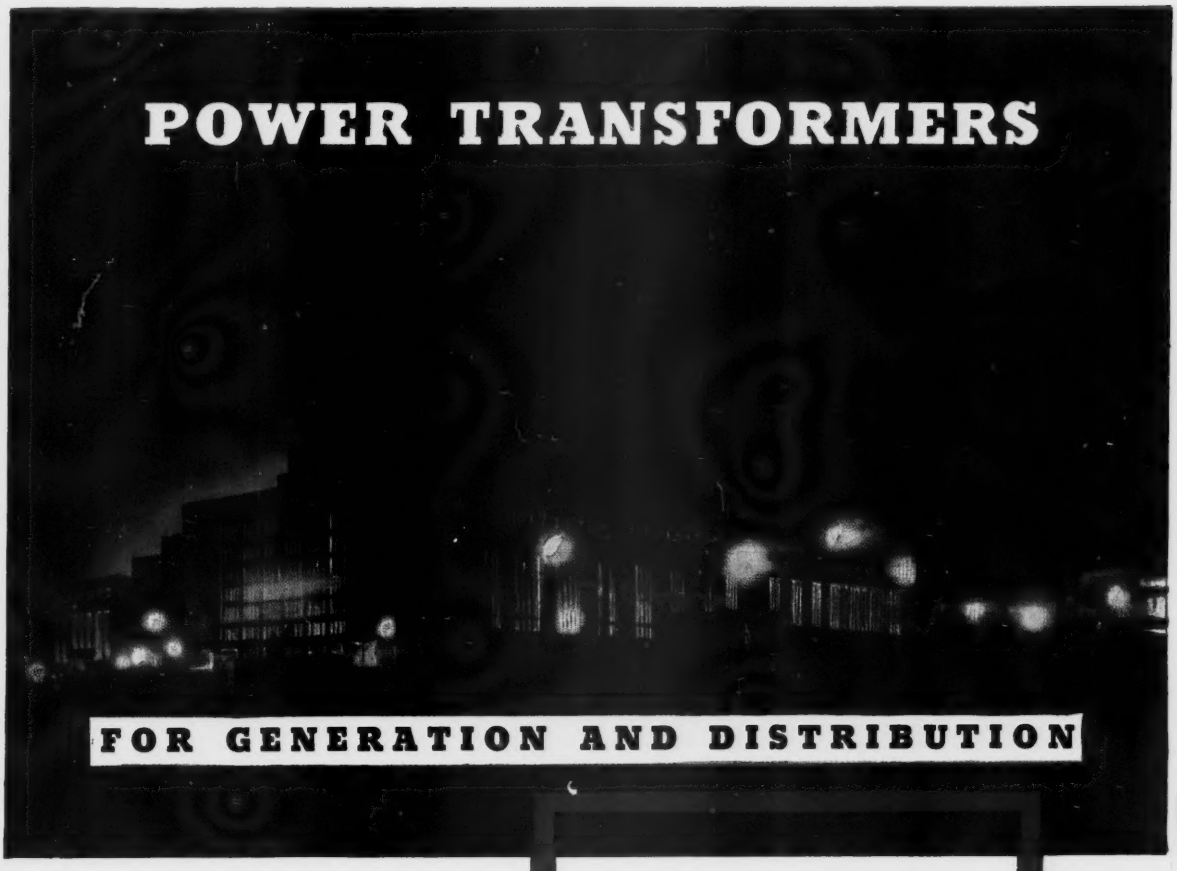

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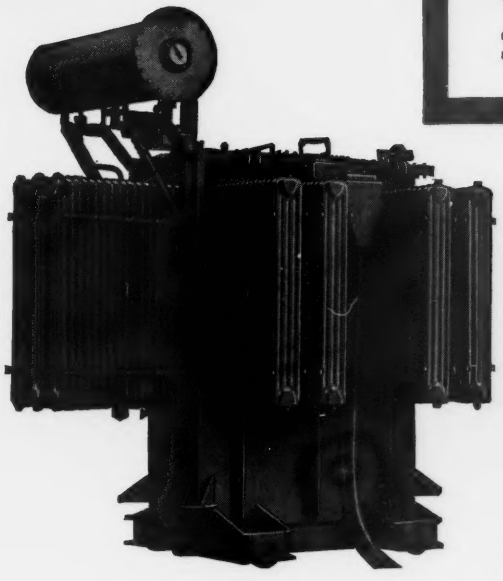

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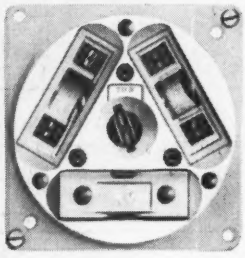

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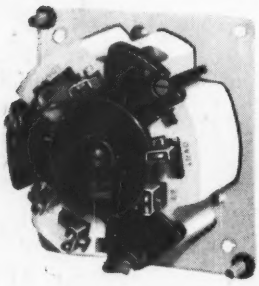
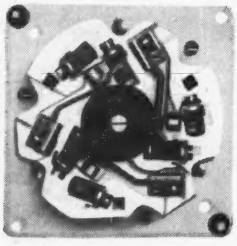


Wiring is especially easy. Heavy clamp terminals are provided and are clearly identified. An indicator shows whether the switch is on or off.



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